TRADE SPACE STUDY FOR THE PERFORMANCE OF HARD ARMOR VERSUS THREAT STRIKING VELOCITY AT RANGE

by
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14. ABSTRACT

This report documents an effort, conducted by the Natick Soldier Research, Development and Engineering Center between September 2013 and September 2014, to quantify the performance of armor designs as a function of armor areal density against specific small arms threats. The metrics used in the analysis were V0 and V50. The armor designs evaluated were similar in construction to the currently fielded Enhanced Small Arms Protective Inserts (ESAPI) and X Small Arms Protective Inserts (XSAPI). The threats evaluated for each design were classified threats D and Y for the ESAPI designs and threats D and X for the XSAPI designs. A linear correlation was evident between V50 and V0 performance and the armor's areal density. The results of this effort culminated in a series of graphs and charts which characterize V0 and V50 values to the corresponding stand-off from muzzle for each small arms threat by armor design at 10, 20, 30, and 40% reduced weight from the baseline.

15. SUBJECT TERMS

MATHEMATICAL ANALYSIS	TEST AND EVALUATION	SMALL ARMS PROTECTION
PERFORMANCE(ENGINEERING)	PROTECTIVE EQUIPMENT	SMALL ARMS THREATS
SMALL ARMS PROTECTIVE INSERTS	DESIGN CRITERIA	AREAL DENSITY PENETRATION
XSAPI(S SMALL ARMS PROTECTIVE INSERT)	LIGHTWEIGHT	BODY ARMOR SMALL ARMS
XSAPI(X SMALL ARMS PROTECTIVE INSERT)	BALLISTICS	THICKNESS VELOCITY
SAPI(SMALL ARMS PROTECTIVE INSERT) PLATES	ANALYSIS	DENSITY METRICS
ESAPI(ENHANCED SMALL ARMS PROTECTIVE INSERTS)	V50	INSERTS PLATES

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Preface

TRADE SPACE STUDY FOR THE PERFORMANCE OF HARD ARMOR VERSUS THREAT STRIKING VELOCITY AT RANGE

1. Introduction

This report describes a two-phase project to quantify the performance of armor designs as a function of armor areal density against specific small arms threats. The work was performed by the Natick Soldier Research, Development and Engineering Center (NSRDEC) from September 2013 to September 2014. The metrics used in the analysis were V50 ballistic limits and point estimates which approached V0. The armor designs evaluated were similar in construction to the currently fielded Enhanced Small Arms Protective Inserts (ESAPI) and X Small Arms Protective Inserts (XSAPI). The threats evaluated for each design were small arms threats D and Y for the ESAPI designs and small arms threats D and X for the XSAPI designs.

Debates are continually held regarding the weight of body armor and its associated performance and whether the weight is justified by the level of protection afforded. The last systematic study of hard armor systems designed to defeat small arms threats was conducted in 1979 titled *Ballistic Technology of Lightweight Armor* by Francis Mascianica of the Army Materials and Mechanics Research Center in Watertown, Massachusetts. The goal of this study was to generate quantitative data that could be used to inform the discussion about body armor weight and performance and potential future requirements, not to make conclusions or recommendations from this information pertaining to suitability of requirements and levels of protection.

The objective of Phase I was to establish the V50 ballistic limit for each armor design and threat. The objective of Phase II was to characterize the first shot resistance to penetration (RTP) performance approaching V0 and the second shot penetration rate at those velocities about the first shot V0 velocity.

The baseline, or parent, designs for the effort were 3M-Ceradyne's ESAPI Type VI-10 and XSAPI S239A3, which are the most recent and prevalent of their respective armor classes supplied to the US Army by 3M-Ceradyne. The daughter designs were created by reducing the weight of the parent designs while holding the ratio of tile to backing constant to achieve 10, 20, 30, and 40% weight reductions for each armor design. The baseline areal densities for these weight reductions were 7.0 lb/ft^2 for ESAPI and 7.7 lb/ft^2 for XSAPI. Phase I consumed 160 ESAPI and 160 XSAPI. Phase II consumed 706 ESAPI and 704 XSAPI. All designs tested were size medium.

2. Phase I: V50 Ballistic Limits

The objective of Phase I was to determine first and second shot V50 ballistic limits.

2.1 Phase I Method

Table 1 lists the test series and corresponding information for all designs tested. For Phase I, 40 inserts of each of the eight designs were tested to establish the first and second shot V50 ballistic limits. Each armor design was tested against two threats; therefore, 20 inserts were tested per armor design and threat series. Chesapeake Testing was the commercial ballistic test laboratory used for all testing.

Table 1. Phase I Test Series Information

Series	Plate Type	% Weight Reduction	Areal Density (lb/ft^2)	Threats Tested	Quantity
3000	ESAPI	10%	6.30	D, Y	40
3001	ESAPI	20%	5.60	D, Y	40
3002	ESAPI	30%	4.90	D, Y	40
3003	ESAPI	40%	4.20	D, Y	40
3004	XSAPI	10%	6.93	D, X	40
3005	XSAPI	20%	6.16	D, X	40
3006	XSAPI	30%	5.39	D, X	40
3007	XSAPI	40%	4.62	D, X	40
Total					320

All test operating procedures were executed per CO/PD 04-19H Purchase Description, Personal Armor, Enhanced Small Arms Protective Insert (ESAPI) dated 4 March 2013 [1] and FQ/PD 07-03D Purchase Description, Personal Armor, X Small Arms Protective Insert (XSAPI) dated 4 March 2013 [2] for the respective ESAPI and XSAPI armor designs. All designs were tested in conjunction with a Pathfinder S shootpack as defined in AR/PD 11-01A Purchase Description, Shootpack, Ballistic Testing dated 24 February 2011 [3].

When an insert is tested in conjunction with a shootpack the order of the materials in terms of the line of sight of the impacting bullet is first the armor insert, then the shootpack material, and then the clay witness material. The penetration events and their corresponding acronyms are defined and listed in Table 2, in sequence to the line of the flight of the projectile. The data captured during Phase I pertained to penetration and perforation of the different layers which comprise the armor system. In instances where the bullet penetrated into the shootpack, the number of plies perforated was recorded.

Table 2. Penetration Terms

Term	Description	Acronym
Partial Penetration	Bullet penetrates into the hard armor insert, but does not perforate the rear of the hard armor insert.	PP
Plate Complete Penetration	Bullet perforates the rear of the hard armor insert and may or may not penetrate into the shootpack, but does not perforate the rear of the shootpack.	CP
System Complete Penetration	Bullet perforates the hard armor insert and the shootpack and is embedded into the clay witness material.	CC

A "complete penetration" during V50 ballistic limit testing per the purchase descriptions is "when the impacting projectile or any fragment thereof, or any fragment of the test specimen perforates the rear surface of the ESAPI/XSAPI." [1, 2] This definition corresponds to CP in Table 2. The determination of the V50 ballistic limit was based upon the demarcation between PPs and CPs. Events defined as CC were also captured and analyzed. Logistic regression models (LRMs) were used to calculate V50 ballistic limits based on both CC and CP. The LRMs were produced using SAS Institute Inc. JMP ® 10.0.0.

The ESAPI armor designs at reduced weight were based upon 3M-Ceradyne's ESAPI Type VI-10 design. All ESAPI armor designs shared the same components as the Type VI-10 with the exception of the weight and thickness of the ceramic tile and composite backing. The ratio of the tile to backing for all designs was kept the same as the parent design. The weight and thickness of the tile and backing were reduced proportionately so that each insert was 10, 20, 30, or 40% below the baseline weight. The ESAPI armor designs were tested against threats D and Y.

The XSAPI armor designs were similar to the ESAPI designs except they were based on 3M-Ceradyne's XSAPI S239A3 design. All XSAPI armor designs shared the same components as the S239A3 with the exception of the weight and thickness of the ceramic tile and composite backing. The ratio of the tile to backing for all designs was kept the same as the parent design. The weight and thickness of the tile and backing were reduced proportionately so that each insert was 10, 20, 30, or 40% below the baseline weight. The XSAPI armor designs were tested against threats D and X.

For V50 testing, all plates were impacted twice (first shot "edge", second shot "crown"), as defined by the respective ESAPI and XSAPI purchase descriptions. The first and second shot RTP were different from one another for a given armor design, and therefore the first and second shot locations had different V50s. During Phase I, after the first shot was impacted, the plate was removed from the clay block and set aside as the next plate was set up for testing. This approach was applied to all 20 plates per armor design and threat to establish the first shot edge location V50. Once all 20 plates were shot, the second shot crown location V50 was then tested. The same plates that were impacted on the edge location were then used to determine the second shot V50.

The test method used to determine the V50 followed MIL-STD-662F [4]. The starting velocity for the 10% reduced weight designs was approximately the muzzle velocity of the respective threat. The starting velocity to determine the V50 of each subsequently lighter design started at the V50 achieved by the design, which was 10% heavier than the given design being tested.

2.2 Phase I Results

CP V50s were successfully established for all combinations of weight reduced plates and threat with the exception of the 10% light ESAPI armor design against threat Y, which took place at velocities up to the maximum capability of the ballistic test range and equipment at approximately 3,900 ft/s. V50 ballistic limits based on CC were successfully determined in more than half of the cases. Tables 3 and 4 list the LRMs by design, threat, shot number and location for the ESAPI and XSAPI designs, respectively. The V50 ballistic limit based on CC was on average 10% greater than when based on CP when combining across all designs, threats, and shot numbers.

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Table 3. Phase I ESAPI LRM V50s

Series	Weight Reduction	AD	Threat	Shot	Impact Location	Shots	CC (ft/s)	CP (ft/s)	CC > CP
3000	10%	6.3	D	1	Edge	20	3056.16	2946.33	4%
3001	20%	5.6	D	1	Edge	20		2585.46	-
3002	30%	4.9	D	1	Edge	20	2295.17	2061.68	11%
3003	40%	4.2	D	1	Edge	20	1546.42	1117.57	38%
3000	10%	6.3	D	2	Crown	20	2920.46	2858.55	2%
3001	20%	5.6	D	2	Crown	20		2610.7	-
3002	30%	4.9	D	2	Crown	20	2200.2	2092.56	5%
3003	40%	4.2	D	2	Crown	20	1566.25	1435.53	9%
3000	10%	6.3	Y	1	Edge	10			-
3001	20%	5.6	Y	1	Edge	20	3622.56	3409.14	6%
3002	30%	4.9	Y	1	Edge	20	2757.57	2483.43	11%
3003	40%	4.2	Y	1	Edge	20	2255.2	2144.75	5%
3000	10%	6.3	Y	2	Crown	10			-
3001	20%	5.6	Y	2	Crown	20		3351.68	-
3002	30%	4.9	Y	2	Crown	20	2944.1	2849.84	3%
3003	40%	4.2	Y	2	Crown	20	2584.43	2261.35	14%

Table 4. Phase I XSAPI LRM V50s

Series	Weight Reduction	AD	Threat	Shot	Impact Location	Shots	CC (ft/s)	CP (ft/s)	CC > CP
3004	10%	6.93	D	1	Edge	20		3058.49	-
3005	20%	6.16	D	1	Edge	20		2616.49	-
3006	30%	5.39	D	1	Edge	20	2351.48	2149.37	9%
3007	40%	4.62	D	1	Edge	20	1469.98	1288.97	14%
3004	10%	6.93	D	2	Crown	20		2903.95	-
3005	20%	6.16	D	2	Crown	20	2734.76	2640.43	4%
3006	30%	5.39	D	2	Crown	20	2395.01	2280.31	5%
3007	40%	4.62	D	2	Crown	20	1780.61	1352.83	32%
3004	10%	6.93	X	1	Edge	20		3218	-
3005	20%	6.16	X	1	Edge	20	3052.72	2850.07	7%
3006	30%	5.39	X	1	Edge	20	2573.44	2353.09	9%
3007	40%	4.62	X	1	Edge	20		1702.1	-
3004	10%	6.93	X	2	Crown	20	3381.03	3250.17	4%
3005	20%	6.16	X	2	Crown	20	3039.74	2997.18	1%
3006	30%	5.39	X	2	Crown	20		2423.95	-
3007	40%	4.62	X	2	Crown	20		1666.28	-

3. Phase II: Resistance to Penetration

The objective of Phase II was to characterize the first shot RTP performance near the V0 for each armor design and threat tested based on CC, and the second shot penetration rate at the velocities near the first shot V0. LRMs were run for each armor design, threat, and shot number and were analyzed to determine the velocities associated with low probability of penetration. From those LRMs updated CC and CP V50s were obtained. This analysis also provided striking velocities for 0.40, 0.30, 0.20, 0.10, 0.05 and 0.01 probabilities of penetration. In addition to RTP data, BFD results were also captured during Phase II.

3.1 Phase II Method

As shown in Table 5, 176 plates were fabricated for each of the eight armor designs in the Phase II build except series 3002, the 30% reduced weight ESAPI, which had two additional plates incorporated for a total of 178

Table 5. Phase II Test Series Information

Series	Plate Type	Weight Reduction	Areal Density (lb/ft^2)	Threats Tested	Quantity
3000	ESAPI	10%	6.30	D, Y	176
3001	ESAPI	20%	5.60	D, Y	176
3002	ESAPI	30%	4.90	D, Y	178
3003	ESAPI	40%	4.20	D, Y	176
3004	XSAPI	10%	6.93	D, X	176
3005	XSAPI	20%	6.16	D, X	176
3006	XSAPI	30%	5.39)	D, X	176
3007	XSAPI	40%	4.62	D, X	176
Total					1410

Phase II threat D testing began at approximately 400 ft/s below the estimated CC V50 ballistic limits from Phase I for all ESAPI and XSAPI designs. Phase II threat Y and X testing began at approximately 300 ft/s below the estimated first shot CC V50 ballistic limit from Phase I for ESAPI and XSAPI, respectively.

To begin the Phase II testing, the CC V50 for each armor design and threat pair was taken from the LRM if enough data were available and was estimated if data were insufficient for modeling. The approach to estimate the CC V50 was based on the average percent increase of the available LRM PP/CC V50 over the LRM PP/CP V50 for a given plate type, threat, and shot number. For example, the missing CC for 20% weight reduction ESAPI threat D shot 1, in Table 3, was estimated by averaging the percent increase of CC over CP (far right column) for the other three ESAPI first shots against threat D (4%, 11%, and 38%) and then adding that average increase (18%) to the CP V50 for series 3001 (2,585.46 ft/s) to obtain an estimated CC V50 of 3,045.9 ft/s.

Each threat/design pair was then tested to determine the first shot RTP. For purposes of the test procedures, the criterion for a V0 was a demonstration of a first shot RTP with a probability of 90% and a 90% LCL. This statistic, referred to as "90/90", is achieved by either recording 22 stops with zero CCs or 37 stops with just one CC based upon the Clopper-Pearson method [5]. Throughout Phase II, each second shot was impacted using the same striking velocity

as its first shot. The rationale was to determine the proportion of second shot penetrations for a given first shot V0. It was determined that there was no value in determining the second shot V0 for each armor design.

For Phase II, a logic if/then based progression was used for determining the striking velocity as data were collected in search of the armor designs V0 for a given threat. As previously stated, the first striking velocity was determined by a fixed decrement from the estimated CC V50. This striking velocity would be held constant within ±25 ft/s after any first shot PP or CP. If the impact resulted in a CC then the subsequent plate's first shot impact velocity would be decremented by 100 ft/s. With this approach each design rapidly established an initial V0, i.e., 22 partial penetrations (CP or PP) and 0 system CCs. After establishing the initial V0, the next group of testing was conducted by increasing the striking velocity from the initial V0 by 100 ft/s. Testing continued in this velocity range until either a second CC or 37 partials and no more than one CC had been observed. This increased the confidence in and around the initial V0.

For designs with enough plates remaining after establishing the "90/90" for the relevant threats, additional data were collected for the CC V50 or velocities were selected to fill in gaps in the probability of penetration curve between the V0 and V50. During this second stage of Phase II testing, when shot 1 V50 testing was performed, second shot velocities were held consistent with the first shot velocity. At the conclusion of all testing, logistic regression was performed on the entirety of the dataset to re-assess the LRM CC V50 and LRM CP V50.

All BFDs were recorded using the FaroArm®, a laser scanner measurement instrument, in accordance with the ESAPI and XSAPI purchase descriptions. BFDs were recorded for first and second shot PP and CP events. The BFDs were binned by 50 ft/s velocity increments. For example, BFDs for velocities greater than 2,850 and less than or equal to 2,900 ft/s were binned as 2,900 ft/s. Velocities greater than 2,900 ft/s and less than or equal to 2,950 ft/s were binned as 2,950 ft/s.

3.2 Phase II Results

As one example, Figure 1 is the LRM based on CC for the 10% reduced weight ESAPI for shot 1 against threat D. The red dots are CCs and the blue dots are impacts that either stopped in the plate (PP) or shootpack (CP).

From the LRM in Figure 1, an "inverse prediction" was run asking the model for several point estimates for the velocity at which the probability of penetration is 0.50, 0.40, 0.30, 0.20, 0.10, 0.05 and 0.01, and to apply a 90% LCL to the point estimate. This request resulted in the output shown in Figure 2, which displays the same LRM curve in Figure 1. Figure 2 includes a point estimate marker indicating the point on the curve which corresponds to probability of penetration and a confidence arrow or band for the 90% LCL. These models were run for every armor design, shot number, and threat combination, and the full results are provided in Appendix A, as is additional detail on Figure 1 (first page of the appendix).
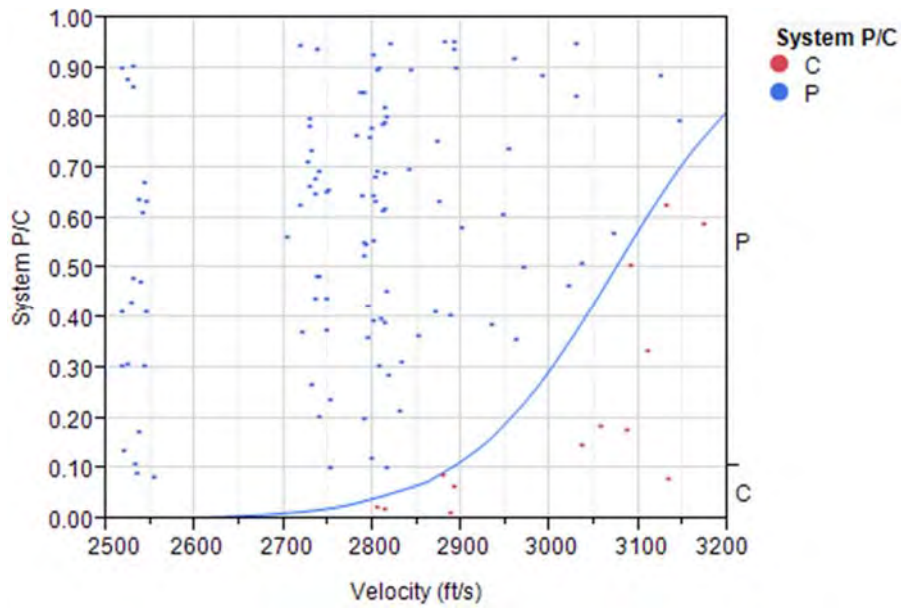
Figure 1. 10% Reduced Weight ESAPI LRM, System Complete Penetration, Shot 1, Threat D

Specified Probability (System P/C=C)	Predicted Velocity (ft/s)	90% LCL (ft/s)
0.5	3072	3028
0.4	3038	2997
0.3	3000	2961
0.2	2954	2913
0.1	2885	2832
0.05	2822	2749
0.01	2681	2556
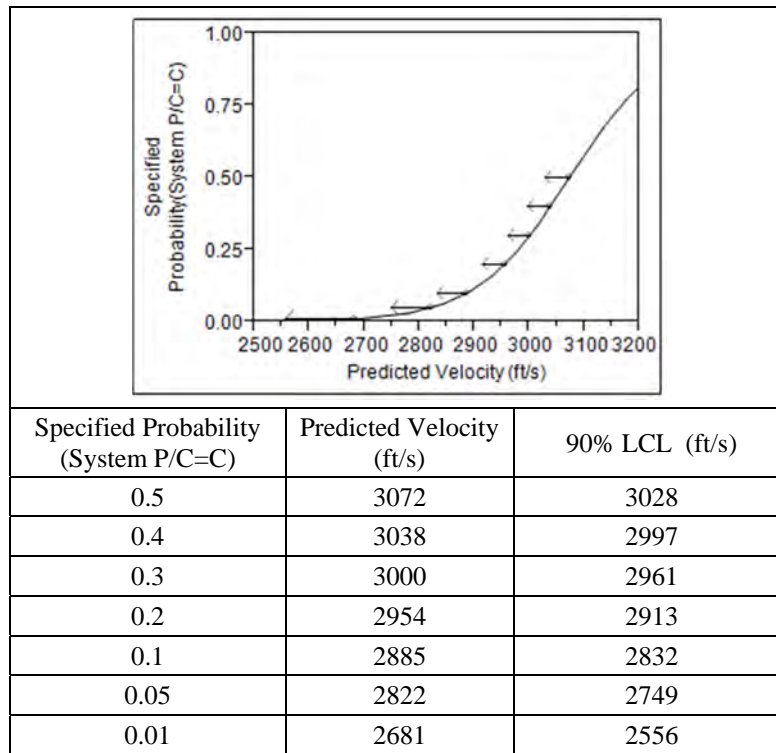
Figure 2. 10% Reduced Weight ESAPI Inverse Prediction, System Complete Penetration, Shot 1, Threat D

One statistic of interest to the US Department of Defense Department of Test and Evaluation (DOT&E) with regards to the evaluation of hard armor systems for the first shot. This statistic was used as a metric to support the evaluation of second shot performance. Once the V10 90% LCL was determined for each armor design and threat, the proportion of second shot CC for a range of velocities about the first shot V10 90% LCL velocity was analyzed. This analysis provided an estimate of the proportion of second shot CC rates for a given first shot V10 90%

LCL. Tables 6 and 7 provide the finalized RTP and V50 ballistic limit metrics across all ESAPI designs and threats for the first and second shots, respectively, and Tables 8 and 9 provide the same data for the XSAPI designs. All of the results for each shot are provided in frequency charts found in Appendix B. From these charts proportions of PP, CP and PP can be seen visually as a function of impact velocity.

Table 5. Phase II ESAPI LRMs, Shot 1 (Impact at Edge) Penetration Summary

Series	Weight Reduction	AD (lb/ft^2)	Threat	Shots	CC V50	CP V50	CC V50 > CP V50	CC V10	CC V10 90% LCL
3000	10%	6.3	D	122	3072	2906	6%	2885	2832
3001	20%	5.6	D	72	2817	2491	13%	2592	2499
3002	30%	4.9	D	99	2204	1821	21%	1873	1775
3003	40%	4.2	D	106	1403	1140	23%	1297	1259
3000	10%	6.3	Y	94	*	*	*	*	*
3001	20%	5.6	Y	144	3519	3071	15%	2714	2519
3002	30%	4.9	Y	119	2597	2485	4%	2421	2366
3003	40%	4.2	Y	110	2461	2165	14%	2245	2175

*Obtained one CC at 3,392 ft/s and four CPs, insufficient to estimate a V50.

Table 6. Phase II ESAPI LRMs, Shot 2 (Impact at Crown) Penetration Summary

Series	Weight Reduction	AD (lb/ft^2)	Threat	Shots	CC V50	CP V50	CC V50 >CP V50	Velocity Range (ft/s)	PP	CP	CC	CC / (PP+CP+CC)
3000	10%	6.3	D	122	*	*	*	2800 - 2900	18	14	15	0.319
3001	20%	5.6	D	72	2945	2501	18%	2350 - 2500	22	10	4	0.111
3002	30%	4.9	D	99	2215	1944	14%	1700 - 1800	15	5	2	0.091
3003	40%	4.2	D	106	1743	1373	27%	1200 - 1300	16	3	1	0.050
3000	10%	6.3	Y	94	**	**	**	3250 - 3950	86	6	2	0.021
3001	20%	5.6	Y	144	3552	3211	11%	2500 - 2600	37	2	1	0.025
3002	30%	4.9	Y	119	2874	2601	11%	2300 - 2400	27	3	1	0.032
3003	40%	4.2	Y	110	2717	2205	23%	2100 - 2200	23	11	4	0.105

* Unable to obtain a defined LRM due to high frequency of CC across the range of velocities tested.

** Obtained two CC's, one at 3,463 ft/s and one at 3,296 ft/s.

Table 7. Phase II XSAPI LRMs, Shot 1 (Impact at Edge) Penetration Summary

Series	Weight Reduction	AD (lb/ft^2)	Threat	Shots	CC V50	CP V50	CC V50 > CP V50	CC V10	CC V10 90% LCL
3004	10%	6.9	D	100	3245	3041	7%	3079	3020
3005	20%	6.2	D	110	2977	2618	14%	2709	2620
3006	30%	5.4	D	105	2444	2078	18%	2217	2112
3007	40%	4.6	D	136	1575	1199	31%	1419	1348
3004	10%	6.9	X	116	3385	3143	8%	3066	2980
3005	20%	6.2	X	106	2954	2810	5%	2808	2760
3006	30%	5.4	X	111	2689	2312	16%	2487	2417
3007	40%	4.6	X	80	*	1665	*	1952	1741

*Insufficient quantity of CC to estimate CC V50

Table 8. Phase II XSAPI LRMs, Shot 2 (Impact at Crown) Penetration Summary

Series	Weight Reduction	AD (lb/ft^2)	Threat	Shots	CC V50	CP V50	CC V50> CP V50	Velocity Range (ft/s)	PP	CP	CC	CC / (PP+CP+CC)
3004	10%	6.9	D	100	*	*	*	2900 - 3000	17	18	15	0.300
3005	20%	6.2	D	110	2806	2532	11%	2550 - 2650	13	8	7	0.250
3006	30%	5.4	D	105	2560	2224	15%	2200 - 2400	10	10	0	0.000
3007	40%	4.6	D	136	1584	1357	17%	1300 - 1400	12	11	0	0.000
3004	10%	6.9	X	116	3562	3319	7%	2900 - 3000	26	3	1	0.033
3005	20%	6.2	X	106	2977	2818	6%	2700 - 2800	15	8	0	0.000
3006	30%	5.4	X	111	2954	2351	26%	2350 - 2450	15	18	0	0.000
3007	40%	4.6	X	80	**	1726	**	1700 - 1800	9	6	0	0.000

* Unable to obtain a defined LRM due to high frequency of CC across the range of velocities tested
** Insufficient quantity of CCs to estimate the CC V50

Tables 10 and 11 show the mean and standard deviations for BFDs about the first shot V10 90% LCL velocity and corresponding second shot, respectively, for the ESAPI designs, and Tables 12 and 13 show the same data for the XSAPI designs. Appendix C contains a detailed set of tables and charts for BFDs across the armor designs and threat combinations.

Table 9. Phase II ESAPI LRMs, Shot 1 (Impact at Edge) BFD Summary

Series	Weight Reduction	AD (lb/ft^2)	Threat	CC V10	CC V10 90% LCL	Velocity Bin (ft/s)	Number of BFD	BFD Mean (mm)	BFD Std Dev (mm)
3000	10%	6.3	D	2885	2832	2850	21	42.03	2.50
3001	20%	5.6	D	2592	2499	2400	23	39.47	4.77
3002	30%	4.9	D	1873	1775	1800	21	27.90	3.72
3003	40%	4.2	D	1297	1259	1250	13	16.01	2.26
3000	10%	6.3	Y	*	*	3400	37	18.56	2.09
3001	20%	5.6	Y	2714	2519	2600	24	14.34	1.81
3002	30%	4.9	Y	2421	2366	2400	21	13.88	1.04
3003	40%	4.2	Y	2245	2175	2150	33	14.02	1.02

*Obtained one CC at 3,392 ft/s and four CP's, insufficient to estimate a V50.

Table 10. Phase II ESAPI LRMs, Shot 2 (Impact at Crown) BFD Summary

Series	Weight Reduction	AD (lb/ft^2)	Threat	Velocity Bin (ft/s)	Number of BFD	BFD Mean (mm)	BFD Std Dev (mm)
3000	10%	6.3	D	2850	15	42.32	5.35
3001	20%	5.6	D	2400	21	30.01	4.43
3002	30%	4.9	D	1800	16	21.43	1.46
3003	40%	4.2	D	1250	11	13.30	1.26
3000	10%	6.3	Y	3400	34	16.99	1.46
3001	20%	5.6	Y	2600	20	11.38	1.72
3002	30%	4.9	Y	2400	17	12.81	0.92
3003	40%	4.2	Y	2150	31	12.49	1.10

Table 11. Phase II XSAPI LRMs, Shot 1 (Impact at Edge) BFD Summary

Series	Weight Reduction	AD (lb/ft^2)	Threat	CC V10	CC V10 90% LCL	Velocity Bin (ft/s)	Number of BFD	BFD Mean (mm)	BFD Std Dev (mm)
3004	10%	6.93	D	3079	3020	3000	37	42.22	2.51
3005	20%	6.16	D	2709	2620	2600	13	43.61	3.89
3006	30%	5.39	D	2217	2112	1950	14	32.41	2.07
3007	40%	4.62	D	1419	1348	1300	12	20.52	2.63
3004	10%	6.93	X	3066	2980	3000	14	39.21	4.39
3005	20%	6.16	X	2808	2760	2800	11	37.83	3.32
3006	30%	5.39	X	2487	2417	2400	14	35.37	2.63
3007	40%	4.62	X	1952	1741	1700	12	23.39	2.39

Table 12. Phase II XSAPI LRMs, Shot 2 (Impact at Crown) BFD Summary

Series	Weight Reduction	AD (lb/ft^2)	Threat	Velocity Bin (ft/s)	Number of BFD	BFD Mean (mm)	BFD Std Dev (mm)
3004	10%	6.93	D	3000	25	43.11	4.93
3005	20%	6.16	D	2600	12	38.32	5.22
3006	30%	5.39	D	1950	16	24.30	2.63
3007	40%	4.62	D	1300	11	16.21	1.52
3004	10%	6.93	X	3000	14	36.12	2.78
3005	20%	6.16	X	2800	10	36.43	1.86
3006	30%	5.39	X	2400	15	30.03	2.44
3007	40%	4.62	X	1700	12	19.16	0.65

4. Discussion

Several of the first shot metrics evaluated in Phase II could not be estimated with the LRM, as noted in Tables 6-10, due to too few penetrations. This was evident for the 10% reduced weight ESAPI armor design against threat Y. In this pairing of armor design and threat, consistent penetration data were not obtained, and the laboratory reached the physical limits of the test barrel, chamber, and cartridge to further increase the striking velocity. As a result, first shot V50 and V10 data were not obtained using the LRM. A similar instance occurred with the 40% reduced weight XSAPI design against threat X, where an LRM CC V50 was not established; however, an LRM CP V50 was estimated.

As originally stated, the objective was to produce the armor designs for ESAPI and XSAPI at 10, 20, 30, and 40% reduced weights from their threshold requirements of 5.45 lb and 6.00 lb, respectively. These threshold weights correspond to 7.0 lb/ft^2 and 7.7 lb/ft^2 for the ESAPI and XSAPI, respectively. Table 14 provides a comparison of the planned versus actual percent weight reductions, weights, and areal densities.

Table 13. **Planned and Actual Armor Design Weights and Areal Densities**

Series	Plate Type	Planned			Actual		
		Weight Reduction	Weight (lb)	Areal Density (lb/ft^2)	Mean Weight (lb)	Weight Reduction	Areal Density (lb/ft^2)
3000	ESAPI	10%	4.91	6.30	4.85	11.06%	6.23
3001	ESAPI	20%	4.36	5.60	4.32	20.74%	5.55
3002	ESAPI	30%	3.82	4.90	3.76	30.99%	4.83
3003	ESAPI	40%	3.27	4.20	3.22	40.88%	4.14
3004	XSAPI	10%	5.40	6.93	5.36	10.61%	6.88
3005	XSAPI	20%	4.80	6.16	4.74	21.07%	6.08
3006	XSAPI	30%	4.20	5.39	4.15	30.77%	5.33
3007	XSAPI	40%	3.60	4.62	3.57	40.57%	4.58

To determine the actual areal density, the percent weight reduction of each armor design was determined by dividing the actual mean armor design weight by the threshold weight for a size medium ESAPI or XSAPI. The percent weight reduction was then applied to the threshold areal density of the ESAPI (7.0 lb/ft^2) and XSAPI (7.7 lb/ft^2).

The V50 and V10 velocities that resulted from running the LRM's after the completion of Phase II were then plotted against the areal densities in Table 14. Figures 3, 4, and 5, show the plots for both V50 and V10 against areal density, which appear to follow a linear response. Figure 3 shows a plot of the CC based V50s, and Figure 4 shows the CP based V50's. Figure 5 is a plot of the V10 based on CC the data. The horizontal lines in Figure 5 are the test requirement velocities for each coded threat per the ESAPI and XSAPI specifications. The linear fits were done in Microsoft Excel, which uses a least squares fit approach. Larger images of Figures 3, 4, and 5 are provided as Appendix D, to provide a continuous set of enlarged graphics, following the text discussion, of all the data collected during this study.
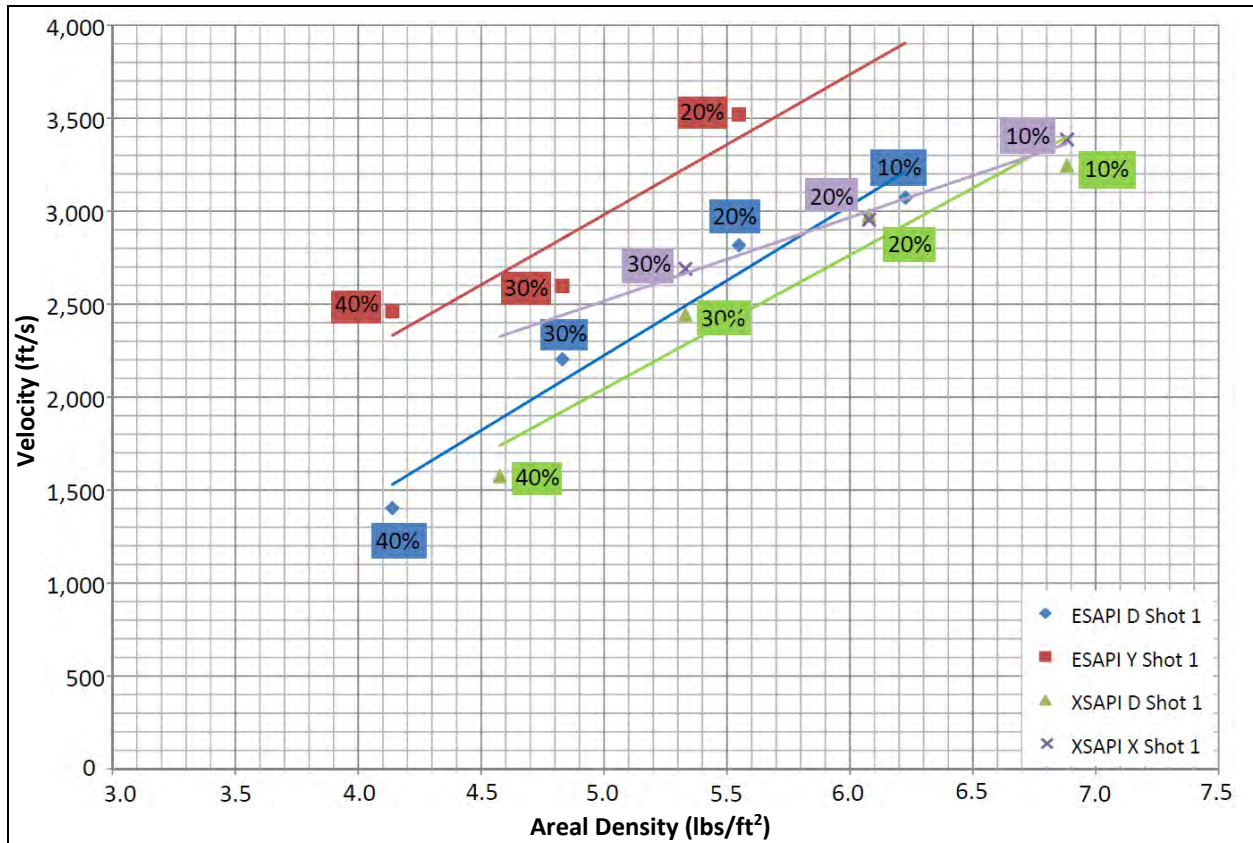
Plate Type	Threat	Linear Regression	R²
ESAPI	D	y = 806.23x - 1807.1	0.9566
ESAPI	Y	y = 754.11x - 789.97	0.8521
XSAPI	D	y = 720.09x - 1556.5	0.9377
XSAPI	X	y = 449.6x + 268.35	0.9867

Figure 3 Shot 1 LRM CC V50 Versus Areal Density, Linear Regression

Plate Type	Threat	Linear Regression	R²
ESAPI	D	y = 855.48x - 2346.8	0.9901
ESAPI	Y	y = 643.72x - 541.1	0.9755
XSAPI	D	y = 789.31x - 2278.4	0.9669
XSAPI	X	y = 641.7x - 1186.1	0.9756
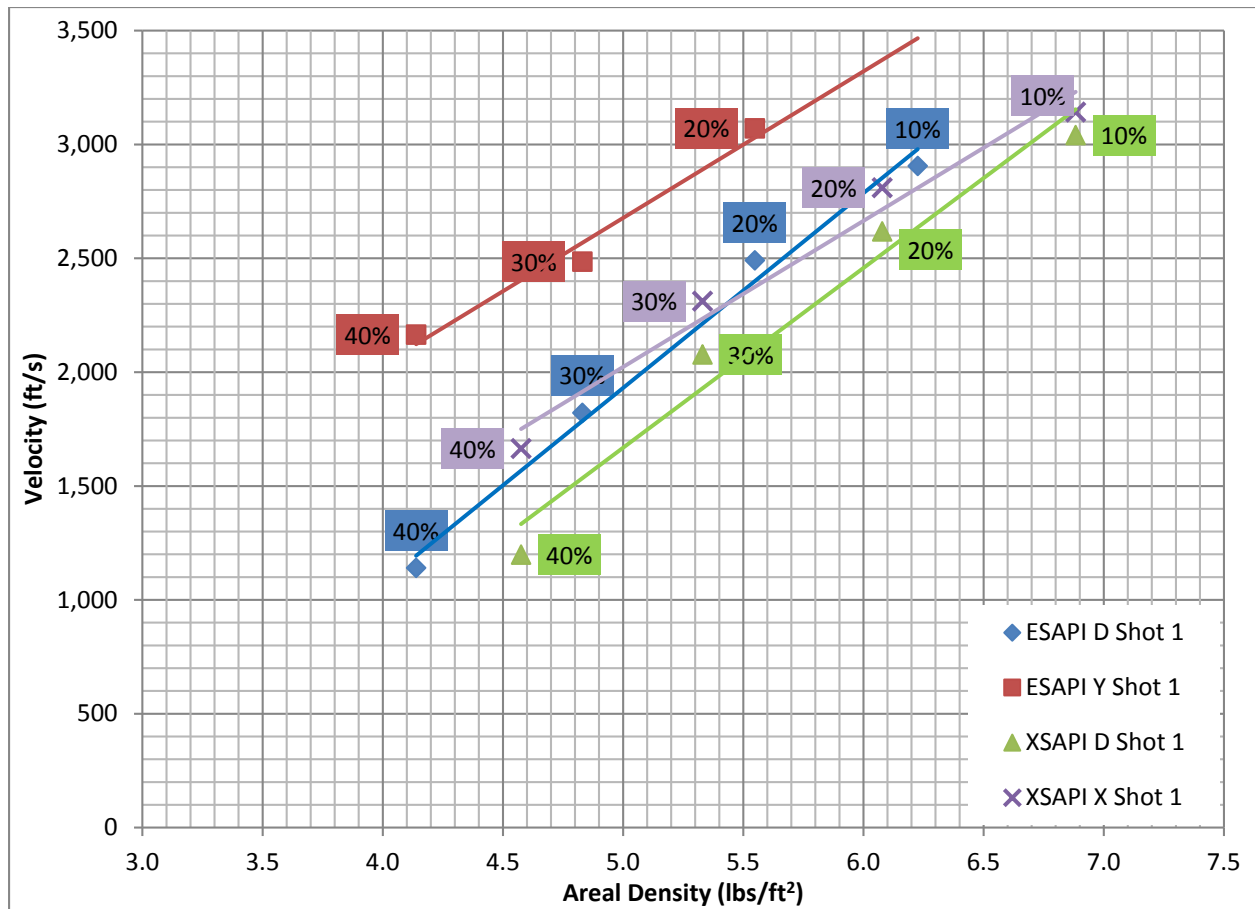
Figure 4. Shot 1 LRM CP V50 Versus Areal Density, Linear Regression
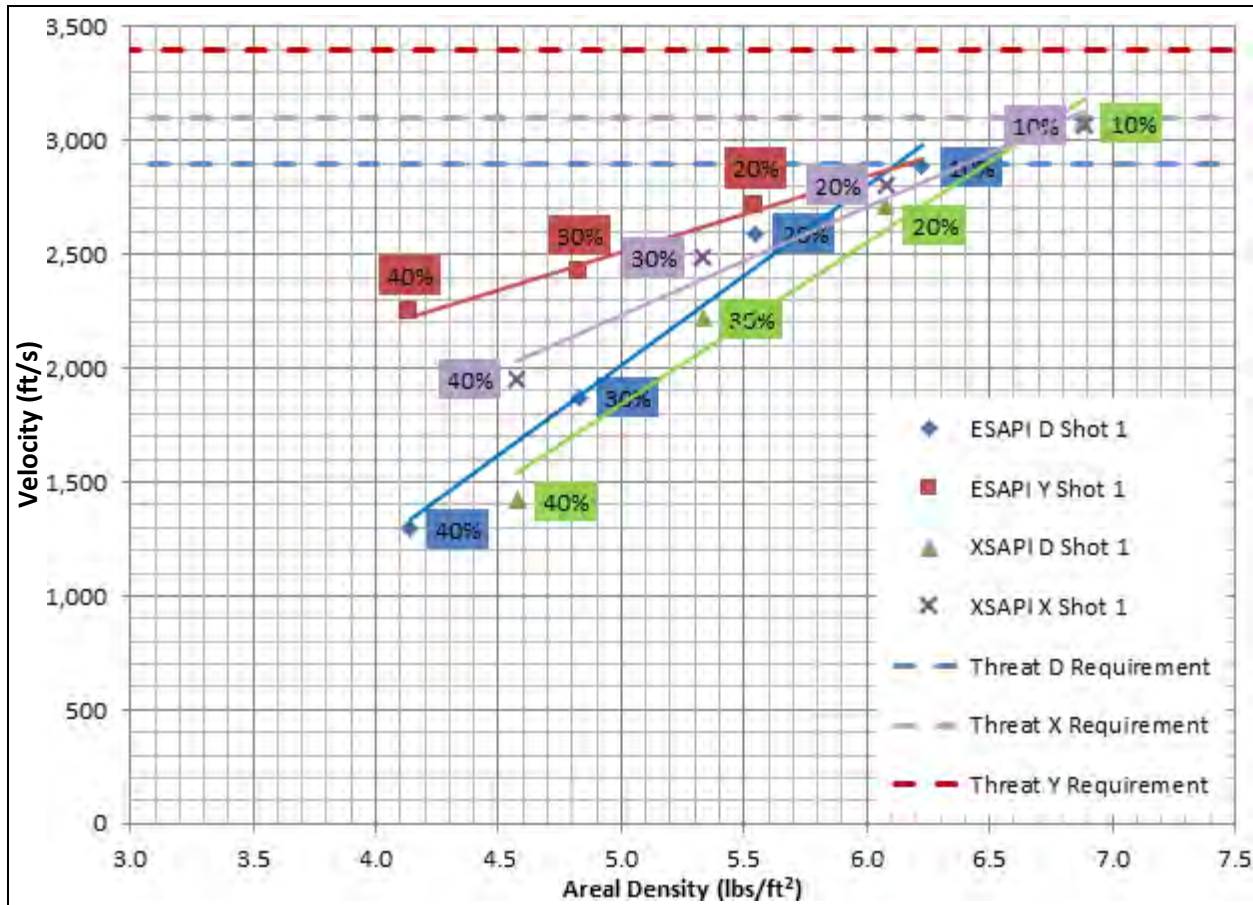
Plate Type	Threat	Linear Regression	R²
ESAPI	D	y = 787.12x - 1920	0.9792
ESAPI	Y	y = 333.38x + 846.7	0.9821
XSAPI	D	y = 711.7x - 1712.6	0.9646
XSAPI	X	y = 476.12x - 143.73	0.9662

Figure 5. Shot 1 LRM CC V10 Versus Areal Density, Linear Regression

An interesting observation from the above plots is the shift in performance between the ESAPI and XSAPI designs against threat D. One might expect that the performance curves should lay over one another. This shift is explained by the fact that ESAPI and XSAPI use different ceramics. ESAPI is primarily designed to provide protection against threat D whereas XSAPI is designed to provide protection against both threats D and X. Threat X contains a different core material than threat D with different penetration mechanics, which create unique challenges compared to threat D.

4.1 Standoff

Threats D, X, and Y each have unique velocity reductions as a function of range or velocity decay. The specific sources from which each threat's velocity decay curve were referenced cannot be cited due to the security classification requirements of the ESAPI and XSAPI programs. The threats by themselves are not classified; however, matching a given threat to an armor system designed to defeat that specific threat is classified information by compilation.

Further inquiry may be sent to the authority cited on the cover page of the report. The velocity at range data for threat D was obtained from a military test standard; however, there are numerous references in the public domain containing different muzzle velocities and velocity decay values indicating a degree of variability of the round's actual performance or measurement techniques. The data for threat X were obtained from an Army Research Laboratory publication. The data for threat Y were obtained directly from Army Research Laboratory, Weapons and Materials Research Directorate (WMRD).

The velocity data for threat D were originally provided in 100 yd increments, and the velocities were reported in units of ft/s. The range was from 0 yd (muzzle) to 1,000 yd. Velocity data for threat X were provided in 100 m increments, and the velocities were reported in units of m/s. The range was from 0 m to 900 m. Velocity data for threat Y were originally provided in 10 m increments, and the velocities were reported in units of m/s. The range was from 0 m to 1,000 m. All ranges were first converted to feet, and all velocities were converted to f/s.

Each data set was plotted in JMP for velocity (ft/s) as a function of range (ft) and fit with a quadratic and cubic polynomial equation. The polynomial fits were established using least squares regression. In each case both polynomials provided R^2 values greater than 0.999; however, the cubic fit was always slightly better and therefore used going forward.

The cubic fit was then used to estimate the velocity at range in 1 ft increments and is shown in Figure 6. From these cubic fits, it was then possible to associate the V50 and any of the other velocities associated with a probability of penetrations for each of the armor design and threat combinations with a given range or standoff from muzzle.

Figure 6. Velocity Degradation as a Function of Range for Threats D, X, and Y.

Table 15 provides a matrix of V50, V10, and V01 based on LRMs using CC data and the corresponding range of standoff from muzzle. To o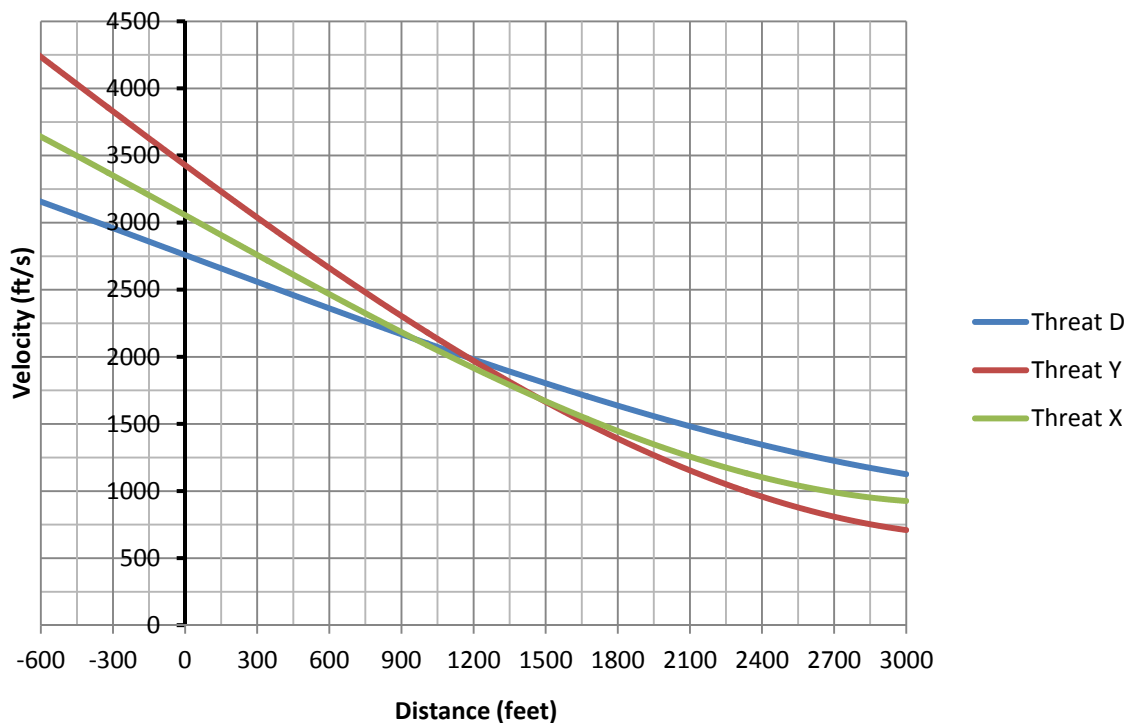btain the range of standoff, these velocity point estimates were compared to the velocity decay curve for each threat. Through that

comparison the respective velocities could then be equated to standoff from muzzle for each threat. For example, the 20% reduced weight ESAPI design had a V10 for threat D at 2,592 ft/s and threat Y a V10 at 2,714 ft/s. For threat D, the 2,592 ft/s velocity was compared against the threat D velocity decay curve and equates to a standoff of 251 ft. For threat Y, the 2,714 ft/s velocity was compared against the threat Y velocity decay curve and equated to a standoff of 558 ft. Standoff reported as a negative value indicates that the velocity for that given metric exceeded the muzzle velocity. The negative standoff followed the cubic fit for the velocity decay curve for that given threat.

Table 14. Association of LRM Shot 1 (Impact at Edge) RTP Metrics to Threat Range of Standoff

Series	Plate Type	Weight Reduction	AD	Threat	Shots	CC V50	Standoff (ft)	CC V10	Standoff (ft)	CC V01*	Standoff (ft)
3000	ESAPI	10%	6.3	D	122	3072	-471	2885	-188	2681	117
3001	ESAPI	20%	5.6	D	72	2817	-86	2592	251	2348	622
3002	ESAPI	30%	4.9	D	99	2204	845	1873	1381	1512	2042
3003	ESAPI	40%	4.2	D	106	1403	2270	1297	2517	1180	2829
3000	ESAPI	10%	6.3	Y	94					3430**	0
3001	ESAPI	20%	5.6	Y	144	3519	-68	2714	558	1836	1329
3002	ESAPI	30%	4.9	Y	119	2597	654	2421	801	2228	968
3003	ESAPI	40%	4.2	Y	110	2461	767	2245	952	2009	1165
3004	XSAPI	10%	6.93	D	100	3245	-736	3079	-482	2898	-208
3005	XSAPI	20%	6.16	D	110	2977	-326	2709	77	2416	518
3006	XSAPI	30%	5.39	D	105	2444	475	2217	824	1970	1219
3007	XSAPI	40%	4.62	D	136	1575	1918	1419	2236	1249	2638
3004	XSAPI	10%	6.93	X	116	3385	-334	3066	-9	2717	344
3005	XSAPI	20%	6.16	X	106	2954	103	2808	252	2647	415
3006	XSAPI	30%	5.39	X	111	2689	372	2487	580	2267	812
3007	XSAPI	40%	4.62	X	80			1952	1159	1313	2007

*Many of the V01 predicted velocities from the LRM are less than the slowest velocity tested. Caution should be taken when using these values as they are outside of the actual velocities tested. LRM's are less reliable when used to identify point estimates outside of the actual range of data.

**The documented muzzle velocity for this threat was listed due to the inability of the threat to consistently defeat the armor system.

Figures 7 and 8 plot the cubic fits for each threat's velocity decay curve and overlay the velocity for the V10 of the ESAPI and XSAPI designs, respectively. Larger images of Figures 6, 7, and 8 are provided as Appendix E, to provide a continuous set of enlarged graphics, following the text discussion, of all the data collected during this study. This overlay was done separately for the ESAPI and XSAPI. These figures provide a visual for relating each V10 velocity for a given armor design and threat to that threat's velocity decay curve. The labels next to the data points lying on each curve indicate the armor design to which that data point corresponds. The horizontal lines are each threat's V0 velocity requirement.

16
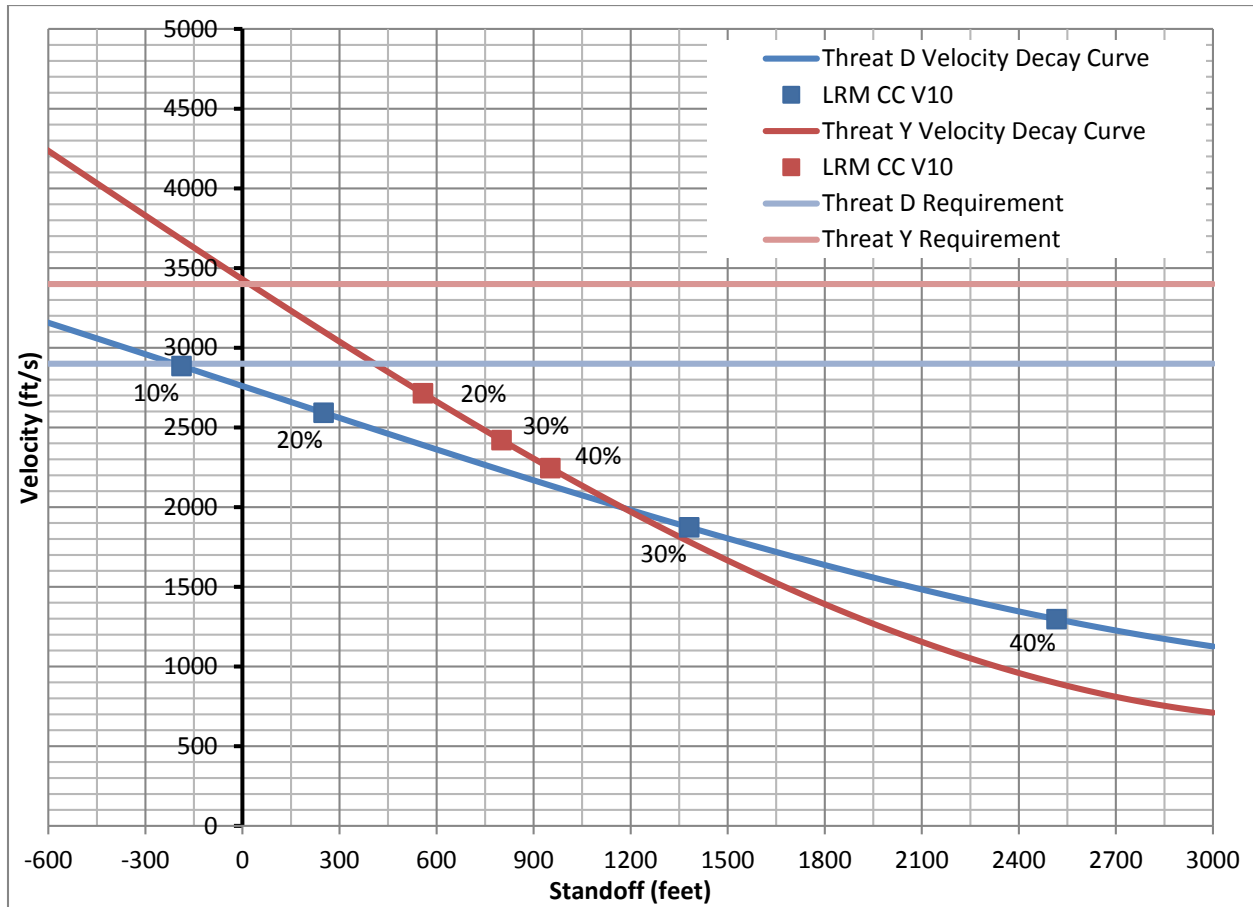
Figure 7. ESAPI Armor Designs V10 Velocity Overlaid onto Threat Velocity Decay Curve

17
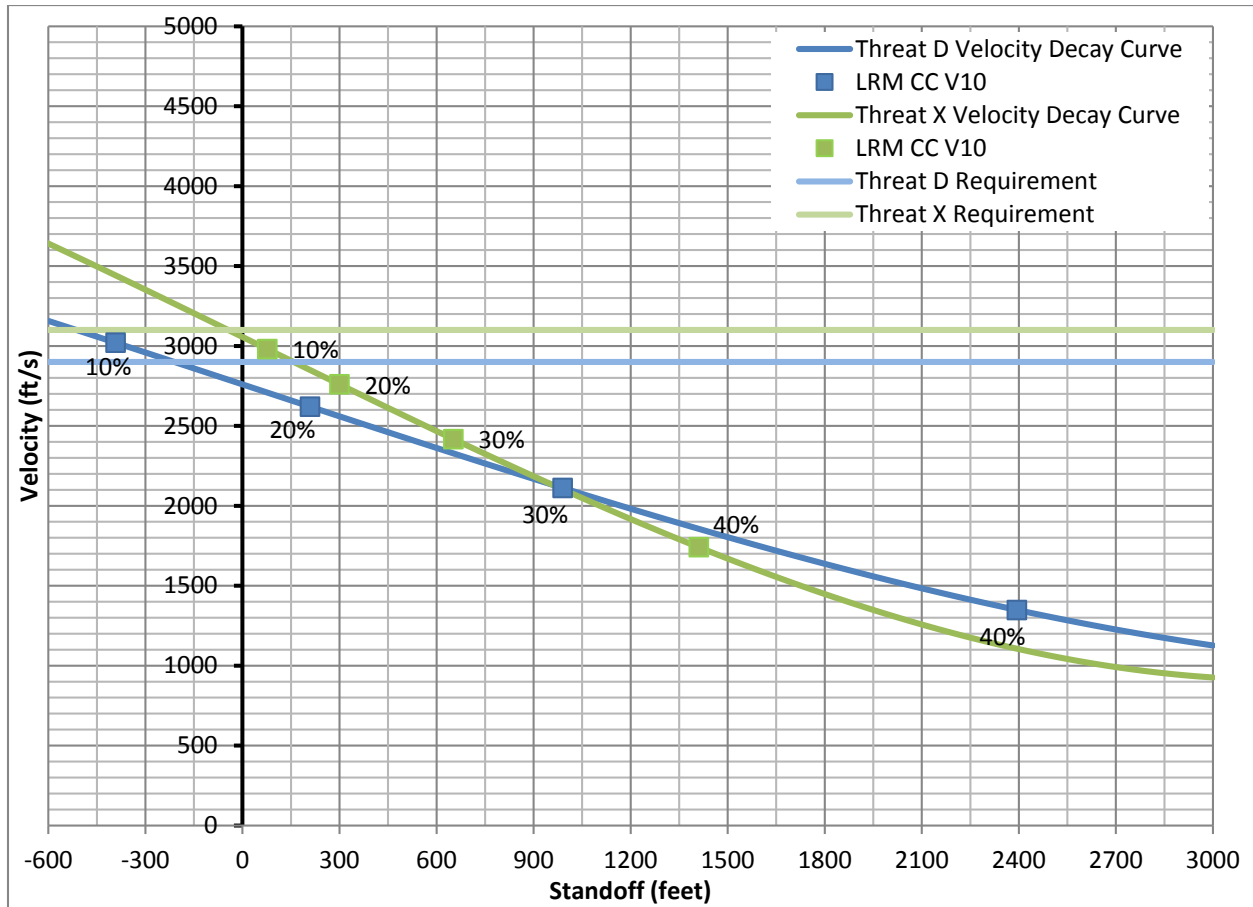
Figure 8. XSAPI Armor Design V10 Velocity Overlaid onto Threat Velocity Decay Curve

4.2 Backface Deformation

BFD data were analyzed a couple of different ways. The first analysis approach, as reported in the Phase II results, was to determine the mean and standard deviation of BFDs near the first shot V10 and V10 90% LCL by armor design for a given threat and shot number. The BFDs are a function of both threat velocity and armor design areal density. As a result, BFD as a function of areal density and BFD as a function of velocity are both confounded by one another when looking for trends across armor designs. Plots of mean BFD versus areal density are included in Appendix C; however, little can be gleaned from the trends. Plots of mean BFD versus velocity are shown in Figures 9 and 10. The velocities used along the x-axes were taken from the "Velocity Bin" column in Tables 11 through 13. The trend was for BFD to increase with increasing velocity. This result was as expected; however, again the confounding of velocity and areal density in the dataset makes it difficult to separate the effects.
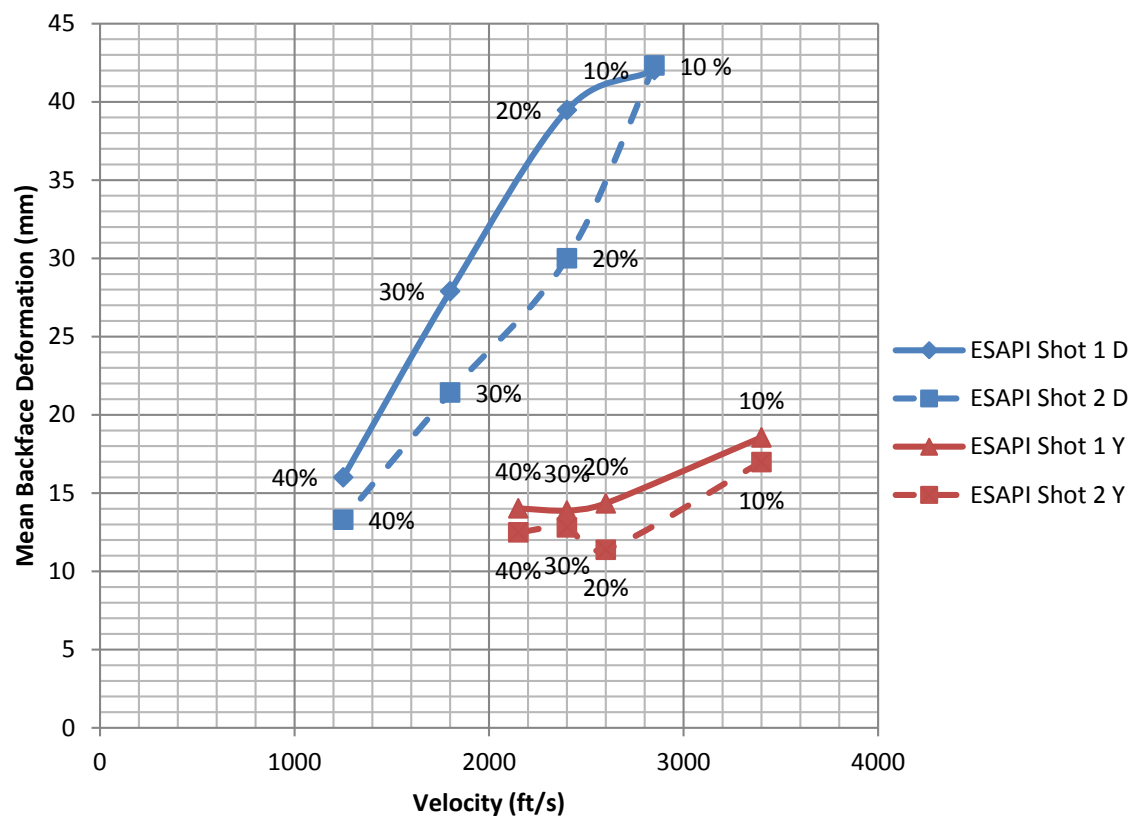
Figure 9. ESAPI Armor Design Backface Deformation as a Function of Velocity Near V10
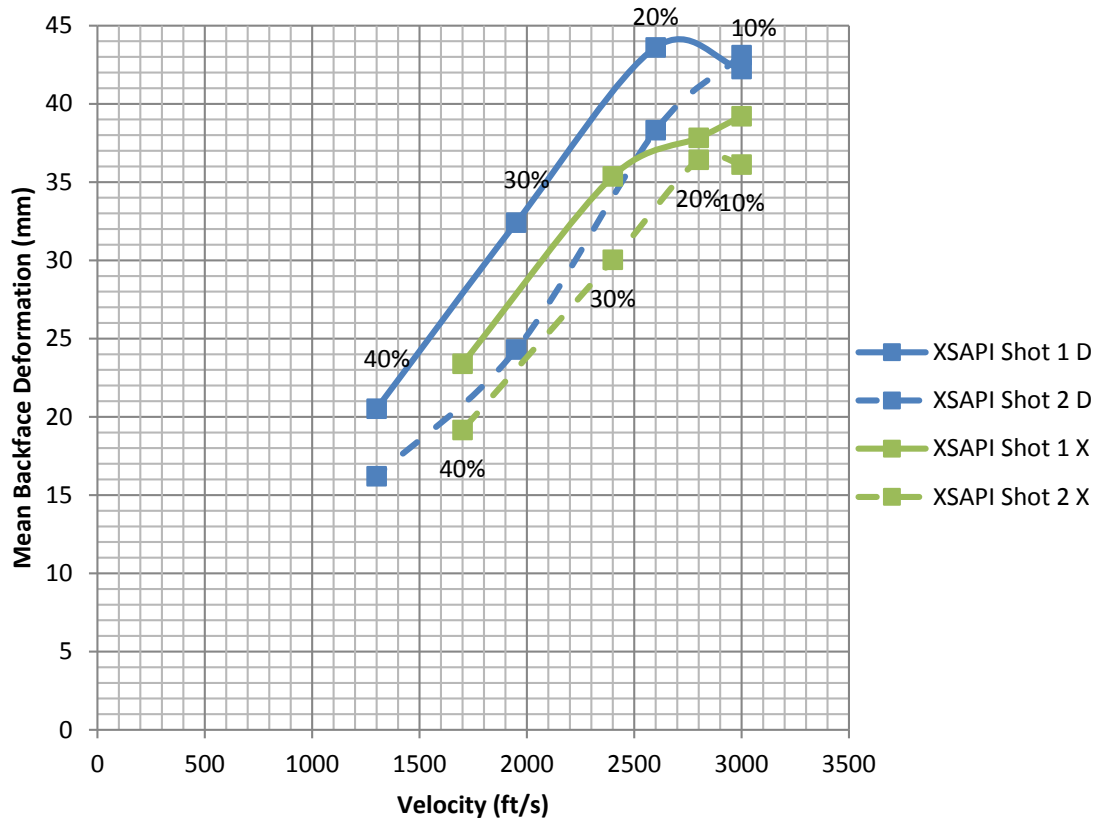
Figure 10. ESAPI Armor Design Backface Deformation as a Function of Velocity Near V10

The second analytical approach was to view the BFDs for each armor design by impact velocity segregated by first and second shot. This perspective of the data was viewed to remove the confounding of areal density when looking at BFDs across armor designs. These plots are found in Appendix C. In general, for all threats for each design, BFD increased with increasing velocity, as expected.

A third perspective of the data was also investigated to see if BFD as a function of areal density could be viewed without the confounding effects of velocity. In order to view this perspective, the armor design data required BFDs over the same impact velocity intervals. Unfortunately the necessary overlap did not occur because the primary objective of the effort was to characterize RTP as a function of areal density.

5. Conclusions

The objective of this study was not to make conclusions or recommendations from this information pertaining to suitability of requirements and levels of protection but rather to generate quantitative data that could be used to inform potential future requirements.

Through both phases, a linear correlation was evident between an armor's areal density and probability of penetration. As the armor areal density was reduced, the V50 and point estimates approaching the V0 decreased linearly. These metrics were compared to the velocity decay curve for each of the threats tested. By comparing the V50 and other point estimates near V0 for each design to the respective threat's velocity decay curve, an estimated range for standoff from the muzzle of the weapon was derived.

The ESAPI and XSAPI armor designs demonstrated a positive linear relationship between ballistic limit and RTP data versus areal density. The slope of this relationship is threat and shot sequence dependent.

When analyzed for a given design, BFD increased with increasing velocity. For each subsequently lighter armor design, the RTP velocities also decreased. Along with those decreasing armor design weights and RTP metrics, the BFDs, in general, also decreased.

The comparison of RTP velocities for each armor design against the respective threats' velocity decay curves provide unique insights. There are distinct tradeoffs between armor weight and protection.

6. References

1. Purchase Description, *Personal Armor, Enhanced Small Arms Protective Insert (ESAPI)*, CO/PD 04-19H, 4 March 2013.

2. Purchase Description, *Personal Armor, X Small Arms Protective Insert (XSAPI)*, FQ/PD 07-03D, 4 March 2013.

3. Purchase Description, *Shootpack, Ballistic Testing*, AR/PD 11-01A, 24 February 2011.

4. Department of Defense Test Method Standard, *V50 Ballistic Test for Armor*, MIL-STD-662F, 18 December 1997.

5. Gilmore, J. Michael, Director, Operational Test and Evaluation, Memorandum, *SUBJECT: Standardization of Hard Body Armor Testing,* 27 April 2010.

Appendix A. Logistic Regression Models

3000 Series 10% Light ESAPI
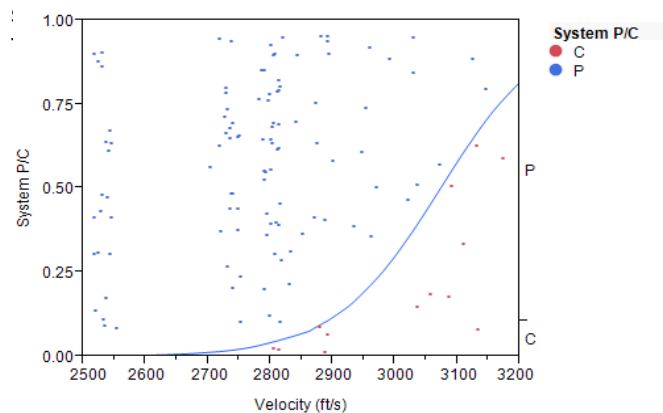
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	13.993326	1	27.98665	<.0001
Full	27.39598			
Reduced	41.389307			

RSquare (U)	0.3381
AICc	58.8928
BIC	64.4
Observations (or Sum Wgts)	122

Measure	Training	Definition
Entropy RSquare	0.3381	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.4161	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.2246	$\sum$ -Log(ρ[j])/n
RMSE	0.2558	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.1306	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.0738	$\sum$ (ρ[j]$\neq\rho$Max)/n
N	122	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-36.120666	8.0712687	20.03	<.0001
Velocity (ft/s)	0.01175764	0.0027285	18.57	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3072.103	3027.619
0.4	3037.617	2996.811
0.3	3000.039	2961.128
0.2	2954.197	2913.351
0.1	2885.226	2831.557
0.05	2821.675	2748.675
0.01	2681.283	2555.59
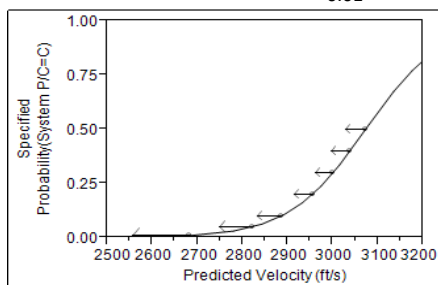
3000 Series 10% Light ESAPI
Shot 2
Threat D - System
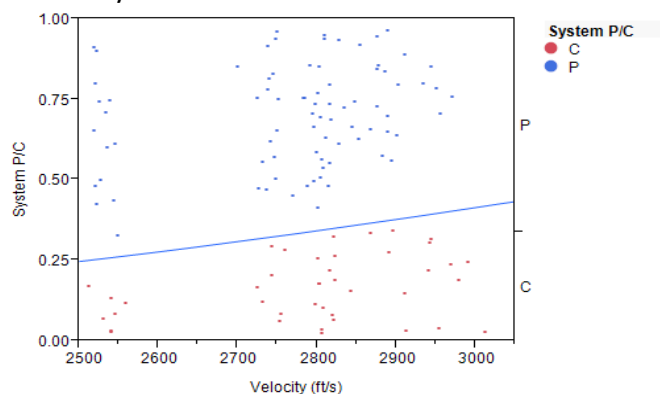
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	0.515226	1	1.030452	0.3101
Full	77.368505			
Reduced	77.883731			

RSquare (U)	0.0066
AICc	158.838
BIC	164.345
Observations (or Sum Wgts)	122

Measure	Training	Definition
Entropy RSquare	0.0066	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.0117	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.6342	$\sum$ -Log(ρ[j])/n
RMSE	0.4702	$\sqrt{\sum (y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.4423	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.3361	$\sum$ (ρ[j]$\neq\rho$Max)/n
N	122	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-4.957481	4.2869982	1.34	0.2475
Velocity (ft/s)	0.00153727	0.0015369	1	0.3172

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3224.864	2954.703
0.4	2961.107	2798.972
0.3	2673.693	.
0.2	2323.073	.
0.1	1795.559	.
0.05	1309.493	.
0.01	235.718	.
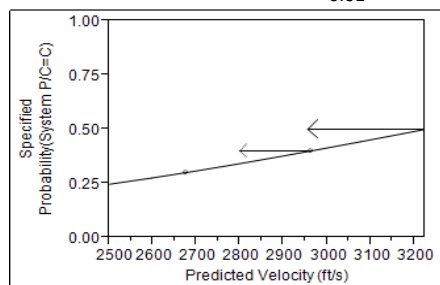
3001 Series 20% Light ESAPI
Shot 1
Threat D - System
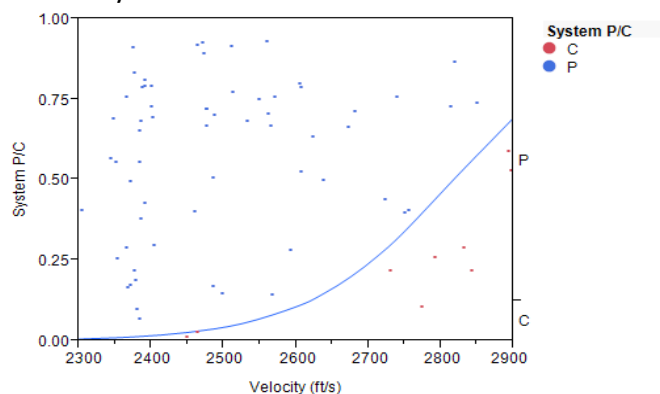
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	8.669215	1	17.33843	<.0001
Full	18.458236			
Reduced	27.127452			

RSquare (U)	0.3196	
AICc	41.0904	
BIC	45.4698	
Observations (or Sum Wgts)	72	

Measure	Training	Definition
Entropy RSquare	0.3196	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.4043	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.2564	$\sum -Log(\rho[j])/n$
RMSE	0.2674	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.1485	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.0972	$\sum (\rho[j]\neq\rho Max)/n$
N	72	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-27.607315	7.7849777	12.58	0.0004
Velocity (ft/s)	0.0098015	0.002885	11.54	0.0007

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2816.643	2755.895
0.4	2775.275	2718.476
0.3	2730.197	2673.583
0.2	2675.206	2610.724
0.1	2592.47	2499.437
0.05	2516.236	2386.147
0.01	2347.825	2123.19
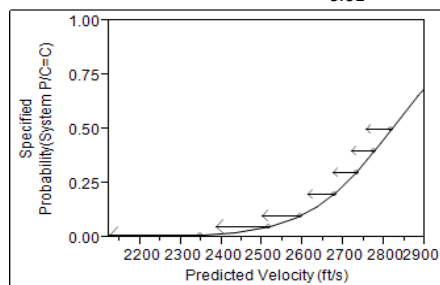
3001 Series 20% Light ESAPI
Shot 2
Threat D - System
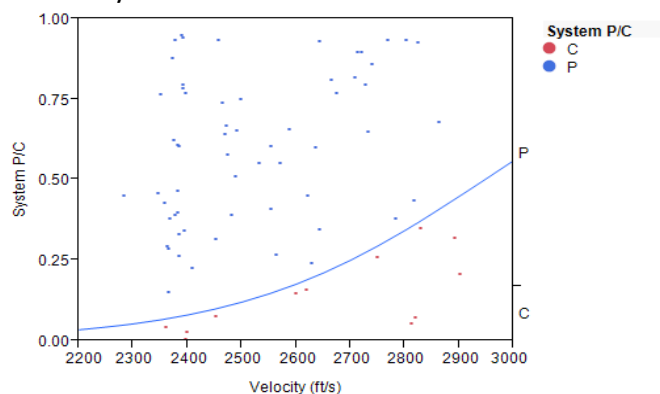
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	2.92395	1	5.847901	0.0156
Full	29.516457			
Reduced	32.440407			

RSquare (U)	0.0901
AICc	63.2068
BIC	67.5862
Observations (or Sum Wgts)	72

Measure	Training	Definition
Entropy RSquare	0.0901	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.1314	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.41	$\sum$ -Log(ρ[j])/n
RMSE	0.3522	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2509	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.1667	$\sum$ (ρ[j]$\neq\rho$Max)/n
N	72	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-13.113322	5.0307682	6.79	0.0091
Velocity (ft/s)	0.00445232	0.0019126	5.42	0.0199

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2945.279	2805.985
0.4	2854.21	2738.961
0.3	2754.974	2657.135
0.2	2633.914	2522.146
0.1	2451.778	2193.674
0.05	2283.952	1834.302
0.01	1913.206	1011.575
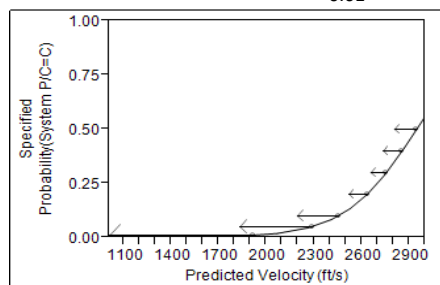
3002 Series 30% Light ESAPI
Shot 1
Threat D - System
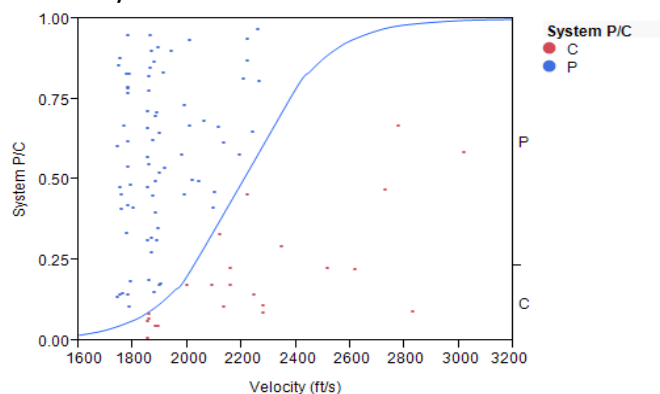
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	16.445576	1	32.89115	<.0001
Full	37.219188			
Reduced	53.664764			

RSquare (U)	0.3065	
AICc	78.5634	
BIC	83.6286	
Observations (or Sum Wgts)	99	

Measure	Training	Definition
Entropy RSquare	0.3065	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.4271	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.376	$\sum$ -Log(ρ[j])/n
RMSE	0.3418	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2323	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.1818	$\sum$ (ρ[j]≠ρMax)/n
N	99	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-14.637157	3.1982129	20.95	<.0001
Velocity (ft/s)	0.00664223	0.0015647	18.02	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2203.652	2138.218
0.4	2142.608	2083.319
0.3	2076.089	2018.404
0.2	1994.942	1929.04
0.1	1872.855	1775.12
0.05	1760.361	1622.329
0.01	1511.848	1273.201
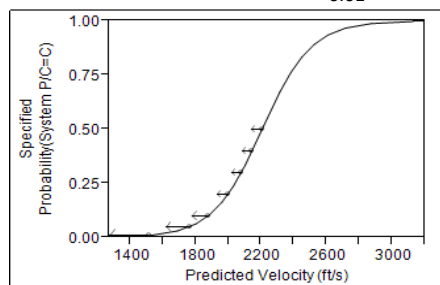
3002 Series 30% Light ESAPI
Shot 2
Threat D - System
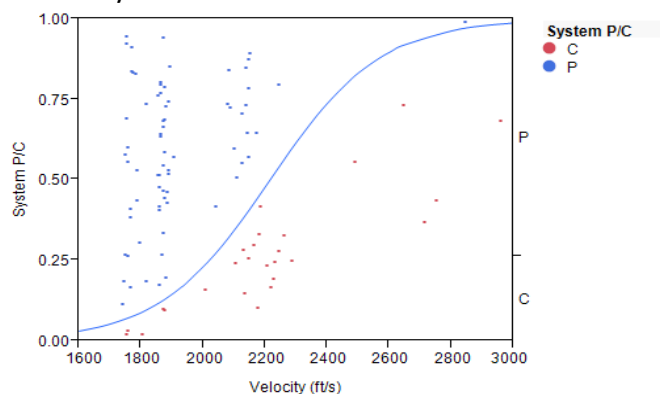
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	13.355886	1	26.71177	<.0001
Full	43.64693			
Reduced	57.002816			

RSquare (U)	0.2343
AICc	91.4189
BIC	96.4841
Observations (or Sum Wgts)	99

Measure	Training	Definition
Entropy RSquare	0.2343	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.3458	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.4409	$\sum$ -Log(ρ[j])/n
RMSE	0.3667	$\sqrt{\sum (y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2751	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.1717	$\sum$ (ρ[j]$\neq\rho$Max)/n
N	99	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-12.438211	2.8817883	18.63	<.0001
Velocity (ft/s)	0.00561659	0.0014042	16	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2214.547	2144.828
0.4	2142.357	2079.693
0.3	2063.691	2000.606
0.2	1967.726	1888.432
0.1	1823.345	1695.289
0.05	1690.308	1506.501
0.01	1396.414	1079.409
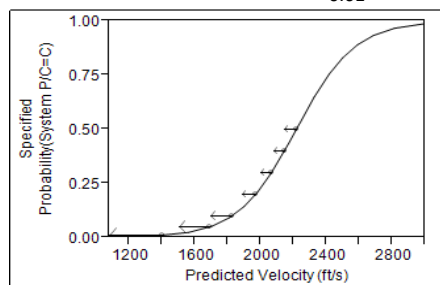
3003 Series 40% Light ESAPI
Shot 1
Threat D - System
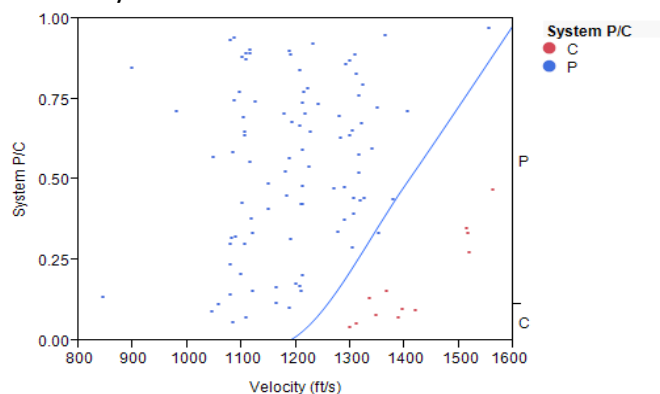
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	17.611958	1	35.22392	<.0001
Full	19.823996			
Reduced	37.435955			

RSquare (U)	0.4705
AICc	43.7645
BIC	48.9749
Observations (or Sum Wgts)	106

Measure	Training	Definition
Entropy RSquare	0.4705	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.5581	$(1-(L(0)/L(model))^{\wedge}(2/n))/(1-L(0)^{\wedge}(2/n))$
Mean -Log p	0.187	$\sum -Log(\rho[j])/n$
RMSE	0.2378	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.111	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.0849	$\sum (\rho[j]\neq\rho Max)/n$
N	106	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-28.9524	7.6195094	14.44	0.0001
Velocity (ft/s)	0.02063406	0.0056911	13.15	0.0003

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1403.137	1373.966
0.4	1383.486	1356.547
0.3	1362.074	1336.06
0.2	1335.952	1307.988
0.1	1296.651	1258.539
0.05	1260.439	1207.62
0.01	1180.441	1088.269
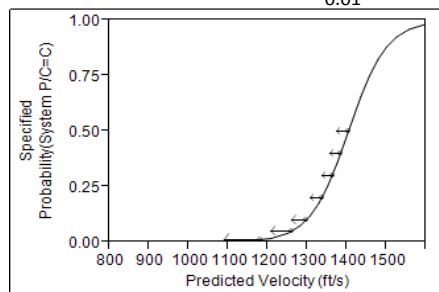
3003 Series 40% Light ESAPI
Shot 2
Threat D - System
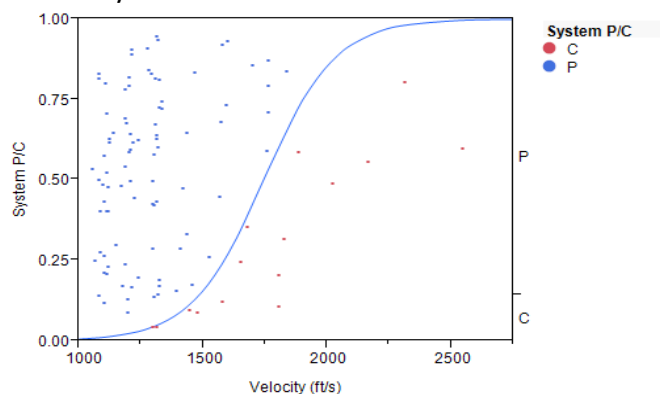
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	18.495348	1	36.9907	<.0001
Full	24.720228			
Reduced	43.215576			

RSquare (U)	0.428
AICc	53.557
BIC	58.7673
Observations (or Sum Wgts)	106

Measure	Training	Definition
Entropy RSquare	0.428	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.5284	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.2332	$\sum -Log(\rho[j])/n$
RMSE	0.2655	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.1379	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.1132	$\sum (\rho[j]\neq\rho Max)/n$
N	106	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-12.022404	2.4768778	23.56	<.0001
Velocity (ft/s)	0.00689924	0.0015723	19.25	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1742.57	1665.736
0.4	1683.8	1612.062
0.3	1619.76	1549.818
0.2	1541.636	1466.846
0.1	1424.096	1326.74
0.05	1315.793	1186.259
0.01	1076.537	859.996
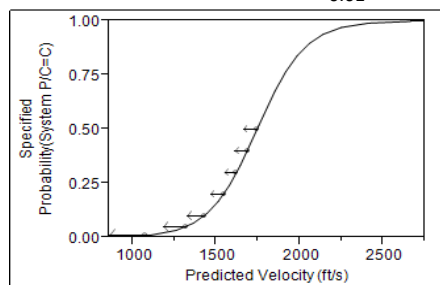
3000 Series 10% Light ESAPI
Shot 1
Threat D - Hard
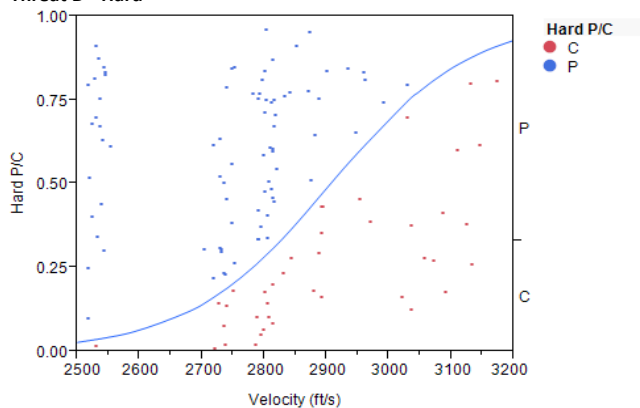
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	16.556831	1	33.11366	<.0001
Full	60.62758			
Reduced	77.184411			

RSquare (U)	0.2145
AICc	125.356
BIC	130.863
Observations (or Sum Wgts)	122

Measure	Training	Definition
Entropy RSquare	0.2145	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.3311	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.4969	$\sum$ -Log(ρ[j])/n
RMSE	0.4048	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3284	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.2459	$\sum$ (ρ[j]$\neq\rho$Max)/n
N	122	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-25.436512	5.4409712	21.86	<.0001
Velocity (ft/s)	0.00875429	0.0019162	20.87	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2905.607	2871.358
0.4	2859.291	2826.294
0.3	2808.82	2771.053
0.2	2747.251	2695.548
0.1	2654.619	2573.278
0.05	2569.264	2457.185
0.01	2380.708	2197.273
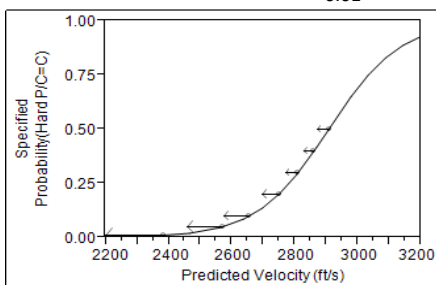
3000 Series 10% Light ESAPI
Shot 2
Threat D - Hard
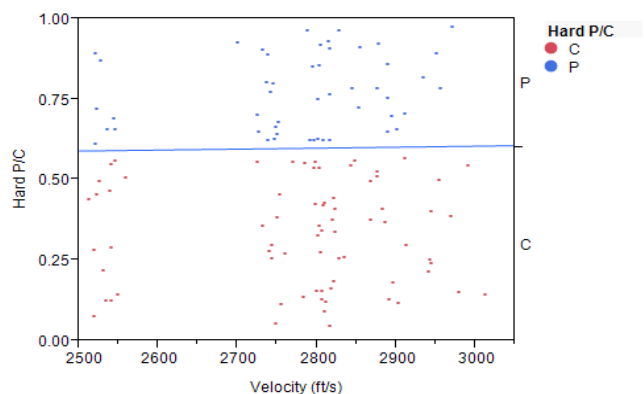
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	0.003845	1	0.00769	0.9301
Full	82.183989			
Reduced	82.187834			

RSquare (U)	0	
AICc	168.469	
BIC	173.976	
Observations (or Sum Wgts)	122	

Measure	Training	Definition
Entropy RSquare	0	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.0001	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.6736	$\sum$ -Log(ρ[j])/n
RMSE	0.4902	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.4806	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.4016	$\sum$ (ρ[j]≠ρMax)/n
N	122	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	0.0515513	3.9607186	0	0.9896
Velocity (ft/s)	0.00012497	0.0014246	0.01	0.9301

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	-412.5	.
0.4	-3657	.
0.3	-7192.4	.
0.2	-11505.4	.
0.1	-17994.3	.
0.05	-23973.4	.
0.01	-37181.9	.
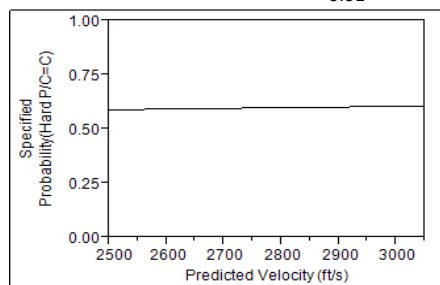
3001 Series 20% Light ESAPI
Shot 1
Threat D - Hard
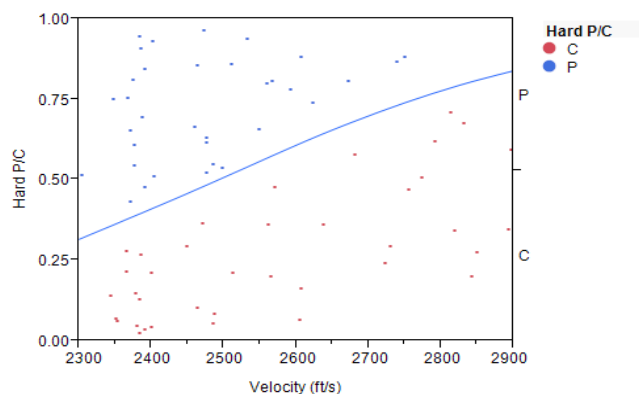
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	3.338879	1	6.677759	0.0098
Full	46.456549			
Reduced	49.795429			

RSquare (U)	0.0671
AICc	97.087
BIC	101.466
Observations (or Sum Wgts)	72

Measure	Training	Definition
Entropy RSquare	0.0671	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.1182	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.6452	$\sum$ -Log(ρ[j])/n
RMSE	0.4783	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.4559	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.4167	$\sum$ (ρ[j]$\neq\rho$Max)/n
N	72	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-10.073046	4.1925526	5.77	0.0163
Velocity (ft/s)	0.00404402	0.0016684	5.88	0.0154

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2490.849	2389.329
0.4	2390.586	2215.145
0.3	2281.331	1997.147
0.2	2148.048	1719.575
0.1	1947.522	1294.961
0.05	1762.752	901.18
0.01	1354.574	28.453
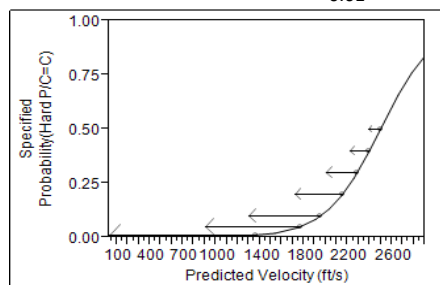
3001 Series 20% Light ESAPI
Shot 2
Threat D - Hard
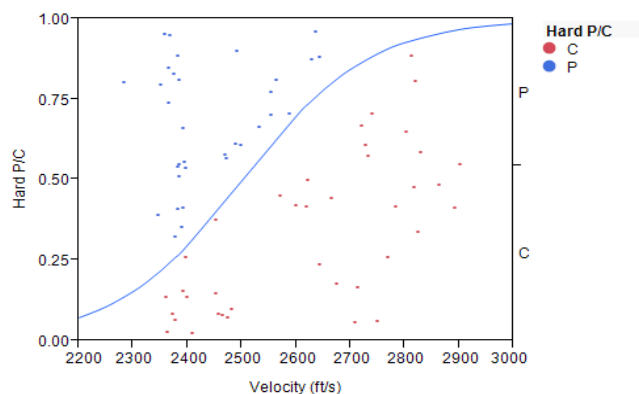
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	12.127323	1	24.25465	<.0001
Full	37.528983			
Reduced	49.656307			

RSquare (U)	0.2442
AICc	79.2319
BIC	83.6113
Observations (or Sum Wgts)	72

Measure	Training	Definition
Entropy RSquare	0.2442	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.3822	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.5212	$\sum$ -Log(ρ[j])/n
RMSE	0.424	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3532	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.3056	$\sum$ (ρ[j]≠ρMax)/n
N	72	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-21.194147	5.2676604	16.19	<.0001
Velocity (ft/s)	0.00847547	0.0021076	16.17	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2500.646	2455.549
0.4	2452.806	2399.679
0.3	2400.676	2332.71
0.2	2337.081	2245.775
0.1	2241.401	2109.968
0.05	2153.239	1982.562
0.01	1958.479	1698.296
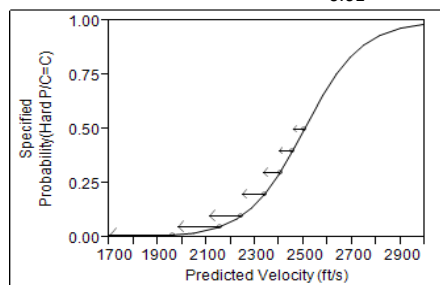
3002 Series 30% Light ESAPI

Shot 1

Threat D - Hard
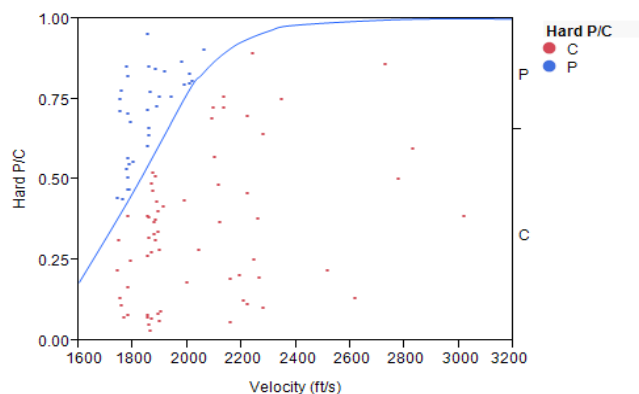
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	10.554075	1	21.10815	<.0001
Full	53.13136			
Reduced	63.685435			

RSquare (U)	0.1657
AICc	110.388
BIC	115.453
Observations (or Sum Wgts)	99

Measure	Training	Definition
Entropy RSquare	0.1657	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2653	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.5367	$\sum$ -Log(ρ[j])/n
RMSE	0.4334	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3726	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.2727	$\sum$ (ρ[j]≠ρMax)/n
N	99	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-12.394389	3.7919809	10.68	0.0011
Velocity (ft/s)	0.00680589	0.002018	11.37	0.0007

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1821.126	1757.987
0.4	1761.551	1671.933
0.3	1696.632	1572.525
0.2	1617.436	1447.957
0.1	1498.285	1257.85
0.05	1388.495	1081.491
0.01	1145.958	690.368
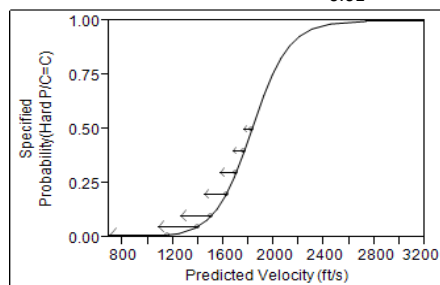
35

3002 Series 30% Light ESAPI
Shot 2
Threat D - Hard
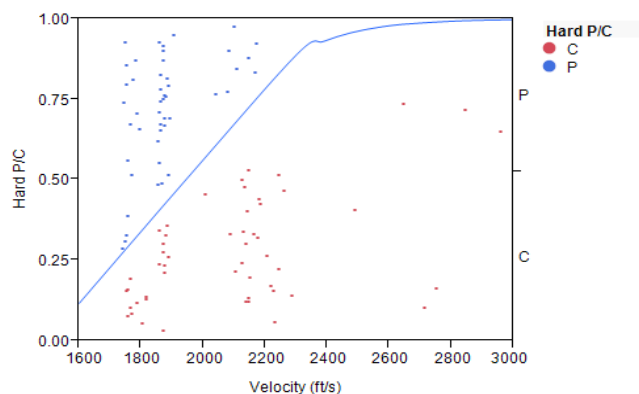
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	12.815059	1	25.63012	<.0001
Full	55.680196			
Reduced	68.495255			

RSquare (U)	0.1871	
AICc	115.485	
BIC	120.551	
Observations (or Sum Wgts)	99	

Measure	Training	Definition
Entropy RSquare	0.1871	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.3044	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.5624	$\sum -Log(\rho[j])/n$
RMSE	0.4401	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3854	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.2828	$\sum (\rho[j]\neq\rho Max)/n$
N	99	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-11.384255	2.788983	16.66	<.0001
Velocity (ft/s)	0.00585486	0.0014375	16.59	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1944.41	1892.155
0.4	1875.157	1811.491
0.3	1799.693	1713.59
0.2	1707.634	1586.659
0.1	1569.128	1389.505
0.05	1441.505	1205.318
0.01	1159.572	795.495
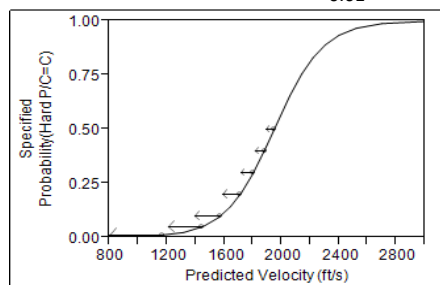
3003 Series 40% Light ESAPI
Shot 1
Threat D - Hard
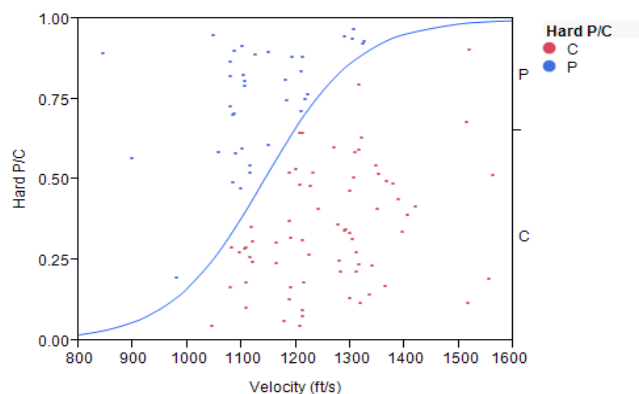
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	15.172314	1	30.34463	<.0001
Full	53.394918			
Reduced	68.567232			

RSquare (U)	0.2213	
AICc	110.906	
BIC	116.117	
Observations (or Sum Wgts)	106	

Measure	Training	Definition
Entropy RSquare	0.2213	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.343	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.5037	$\sum$ -Log(ρ[j])/n
RMSE	0.4105	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3366	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.2547	$\sum$ (ρ[j]$\neq\rho$Max)/n
N	106	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-13.163501	3.0933276	18.11	<.0001
Velocity (ft/s)	0.01154416	0.0026196	19.42	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1140.274	1106.68
0.4	1105.151	1062.323
0.3	1066.877	1011.617
0.2	1020.187	948.041
0.1	949.942	850.756
0.05	885.215	760.322
0.01	742.226	559.457
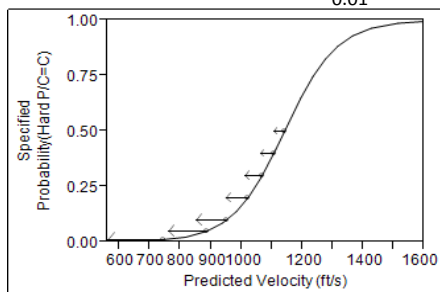
37

3003 Series 40% Light ESAPI
Shot 2
Threat D - Hard
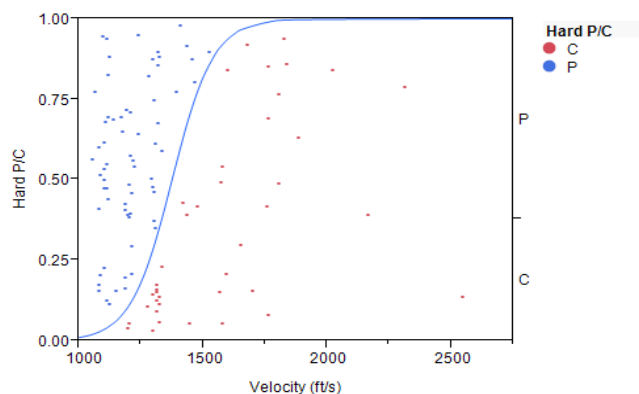
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	33.950689	1	67.90138	<.0001
Full	36.301464			
Reduced	70.252153			

RSquare (U)	0.4833
AICc	76.7194
BIC	81.9298
Observations (or Sum Wgts)	106

Measure	Training	Definition
Entropy RSquare	0.4833	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.6441	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.3425	$\sum -Log(\rho[j])/n$
RMSE	0.3386	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2215	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.1887	$\sum (\rho[j]\neq\rho Max)/n$
N	106	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-16.554104	3.3354106	24.63	<.0001
Velocity (ft/s)	0.01205341	0.0025348	22.61	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1373.396	1340.583
0.4	1339.757	1307.958
0.3	1303.101	1269.401
0.2	1258.383	1217.837
0.1	1191.105	1133.497
0.05	1129.113	1052.132
0.01	992.166	867.967
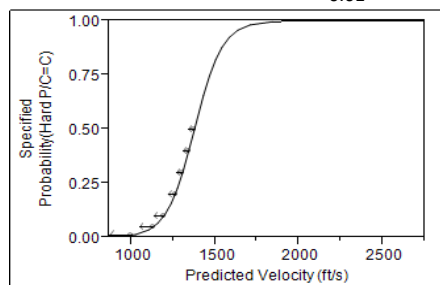
3000 Series 10% Light ESAPI

Shot 1

Threat Y - System
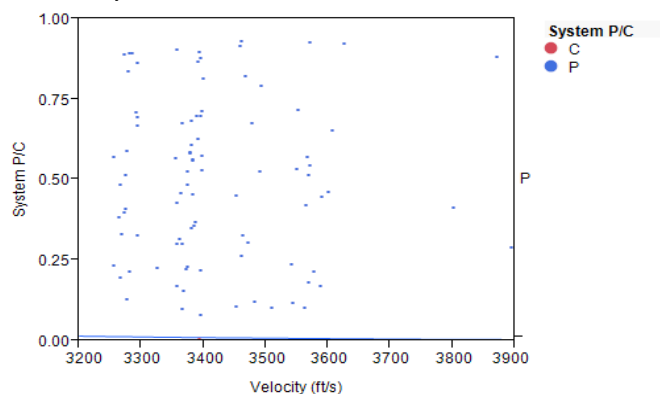
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	0.0211351	1	0.04227	0.8371
Full	5.5168216			
Reduced	5.5379567			

RSquare (U)	0.0038
AICc	15.1655
BIC	20.1202
Observations (or Sum Wgts)	94

Measure	Training	Definition
Entropy RSquare	0.0038	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.004	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.0587	$\sum -Log(\rho[j])/n$
RMSE	0.1026	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.021	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.0106	$\sum (\rho[j]\neq\rho Max)/n$
N	94	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	1.46747276	30.45821	0	0.9616
Velocity (ft/s)	-0.0017626	0.008974	0.04	0.8443

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%	Type of CI
0.5	832.564	.	
0.4	1062.602	.	
0.3	1313.274	.	
0.2	1619.071	.	
0.1	2079.148	.	
0.05	2503.077	.	
0.01	3439.583	2640.07	Wald
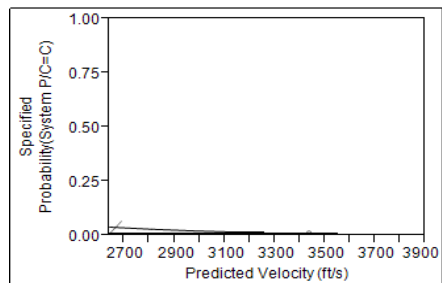
3000 Series 10% Light ESAPI
Shot 2
Threat Y - System
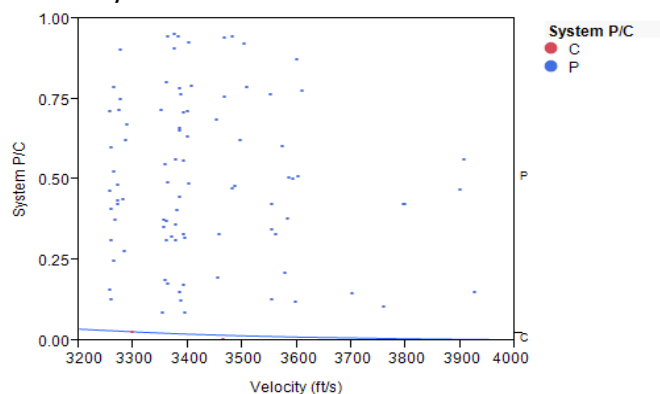
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	0.1229853	1	0.245971	0.6199
Full	9.5558808			
Reduced	9.6788661			

RSquare (U)	0.0127
AICc	23.2436
BIC	28.1984
Observations (or Sum Wgts)	94

Measure	Training	Definition
Entropy RSquare	0.0127	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.014	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.1017	$\sum -Log(\rho[j])/n$
RMSE	0.1442	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.0416	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.0213	$\sum (\rho[j]\neq\rho Max)/n$
N	94	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	5.6607583	20.841311	0.07	0.7859
Velocity (ft/s)	-0.0027894	0.006162	0.2	0.6508

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%	Type of CI
0.5	2029.399	.	
0.4	2174.759	.	
0.3	2333.158	.	
0.2	2526.39	.	
0.1	2817.111	.	
0.05	3084.989	2180.355	Wald
0.01	3676.763	2768.593	Wald
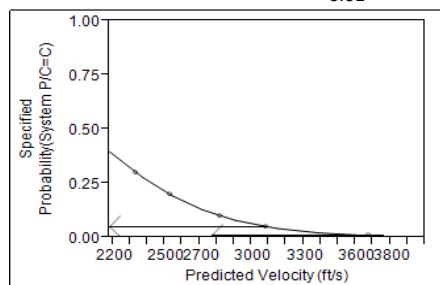
3001 Series 20% Light ESAPI
Shot 1
Threat Y - System
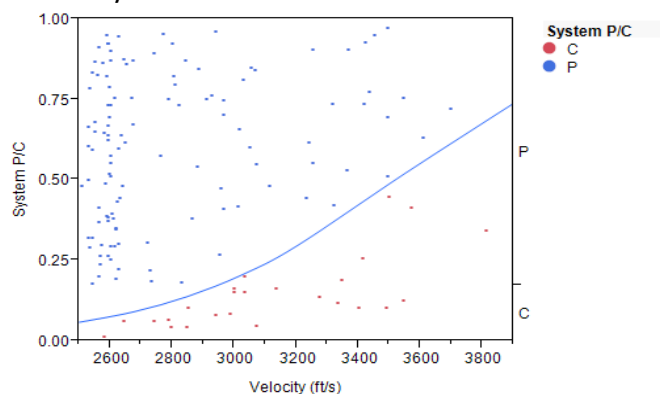
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	9.230413	1	18.46083	<.0001
Full	57.235111			
Reduced	66.465524			

RSquare (U)	0.1389
AICc	118.555
BIC	124.41
Observations (or Sum Wgts)	144

Measure	Training	Definition
Entropy RSquare	0.1389	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.1996	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.3975	$\sum -Log(\rho[j])/n$
RMSE	0.3555	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2488	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.1736	$\sum (\rho[j] \neq \rho Max)/n$
N	144	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-9.6047871	2.0249948	22.5	<.0001
Velocity (ft/s)	0.00272908	0.0006636	16.91	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3519.418	3365.654
0.4	3370.846	3240.619
0.3	3208.948	3094.779
0.2	3011.447	2890.877
0.1	2714.304	2518.586
0.05	2440.507	2139.922
0.01	1835.659	1274.595
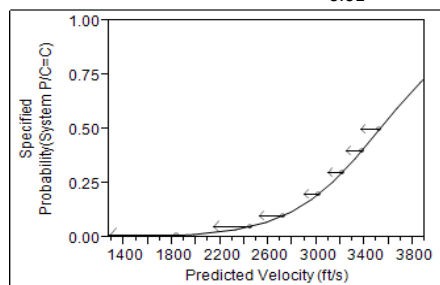
3001 Series 20% Light ESAPI
Shot 2
Threat Y - System
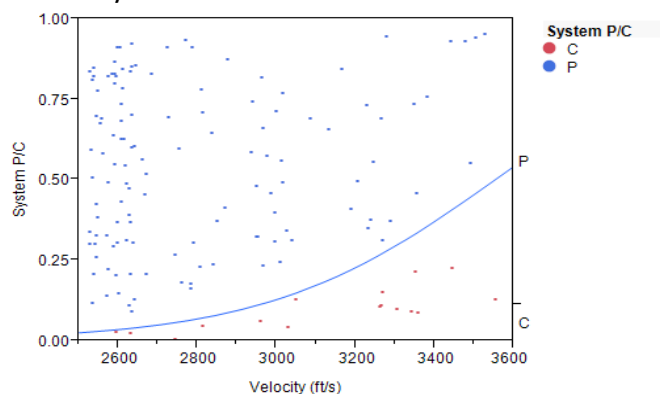
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	8.005649	1	16.0113	<.0001
Full	42.226173			
Reduced	50.231822			

RSquare (U)	0.1594
AICc	88.5375
BIC	94.392
Observations (or Sum Wgts)	144

Measure	Training	Definition
Entropy RSquare	0.1594	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2095	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.2932	$\sum -Log(\rho[j])/n$
RMSE	0.2941	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.172	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.1042	$\sum (\rho[j]\neq\rho Max)/n$
N	144	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-12.313384	2.8463308	18.71	<.0001
Velocity (ft/s)	0.00346695	0.0009238	14.09	0.0002

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3551.644	3396.478
0.4	3434.693	3301.488
0.3	3307.252	3192.786
0.2	3151.785	3045.718
0.1	2917.882	2771.656
0.05	2702.357	2473.159
0.01	2226.239	1768.931
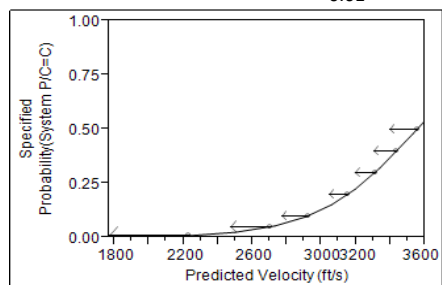
3002 Series 30% Light ESAPI
Shot 1
Threat Y - System
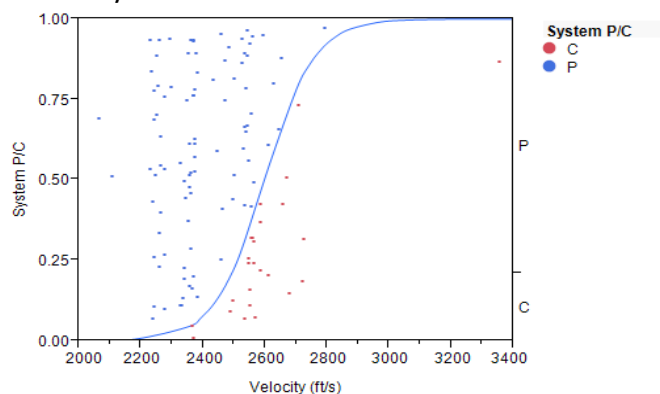
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	19.425789	1	38.85158	<.0001
Full	41.748301			
Reduced	61.174091			

RSquare (U)	0.3175
AICc	87.6001
BIC	93.0548
Observations (or Sum Wgts)	119

Measure	Training	Definition
Entropy RSquare	0.3175	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.4336	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.3508	$\sum$ -Log(ρ[j])/n
RMSE	0.3363	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2248	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.1849	$\sum$ (ρ[j]≠ρMax)/n
N	119	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-32.308945	7.0272665	21.14	<.0001
Velocity (ft/s)	0.01244026	0.0027772	20.07	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2597.127	2566.658
0.4	2564.534	2536.034
0.3	2529.018	2499.397
0.2	2485.691	2449.27
0.1	2420.505	2365.741
0.05	2360.441	2284.797
0.01	2227.752	2101.732
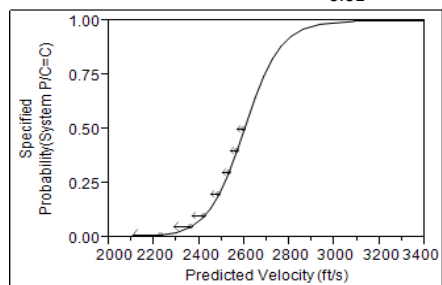
3002 Series 30% Light ESAPI
Shot 2
Threat Y - System
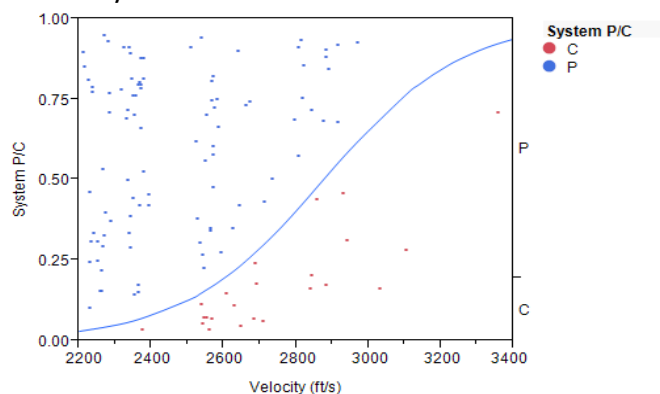
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	12.149422	1	24.29884	<.0001
Full	46.27248			
Reduced	58.421902			

RSquare (U)	0.208	
AICc	96.6484	
BIC	102.103	
Observations (or Sum Wgts)	119	

Measure	Training	Definition
Entropy RSquare	0.208	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2953	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.3888	∑ -Log(ρ[j])/n
RMSE	0.3566	√ ∑(y[j]-ρ[j])²/n
Mean Abs Dev	0.2485	∑ |y[j]-ρ[j]|/n
Misclassification Rate	0.1933	∑ (ρ[j]≠ρMax)/n
N	119	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-14.855759	3.2287183	21.17	<.0001
Velocity (ft/s)	0.00516837	0.0012119	18.19	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2874.362	2796.149
0.4	2795.911	2726.816
0.3	2710.423	2644.704
0.2	2606.135	2530.4
0.1	2449.233	2331.334
0.05	2304.658	2133.948
0.01	1985.277	1684.664
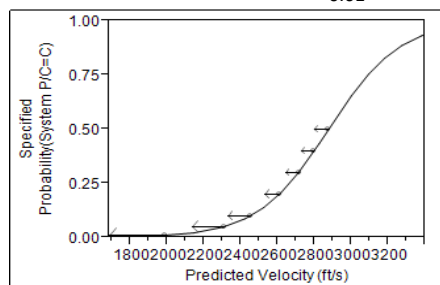
44

3003 Series 40% Light ESAPI
Shot 1
Threat Y - System
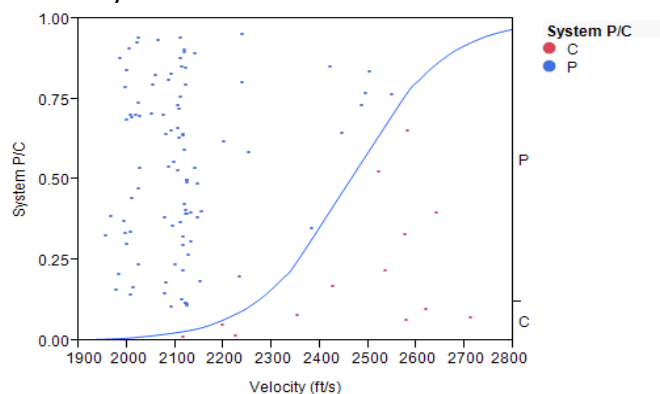
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	19.096115	1	38.19223	<.0001
Full	20.865419			
Reduced	39.961534			

RSquare (U)	0.4779
AICc	45.843
BIC	51.1318
Observations (or Sum Wgts)	110

Measure	Training	Definition
Entropy RSquare	0.4779	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.568	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.1897	$\sum$ -Log(ρ[j])/n
RMSE	0.2355	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.108	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.0818	$\sum$ (ρ[j]$\neq\rho$Max)/n
N	110	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-25.017574	4.9384486	25.66	<.0001
Velocity (ft/s)	0.01016447	0.0020975	23.48	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2461.277	2406.142
0.4	2421.387	2368.287
0.3	2377.919	2324.843
0.2	2324.891	2268.19
0.1	2245.11	2175.495
0.05	2171.598	2084.173
0.01	2009.201	1872.599
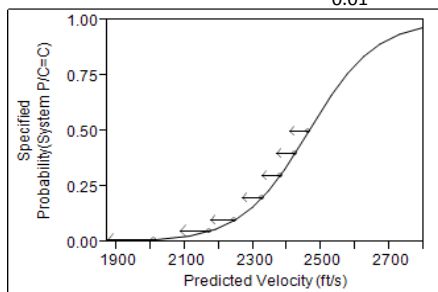
3003 Series 40% Light ESAPI
Shot 2
Threat Y - System
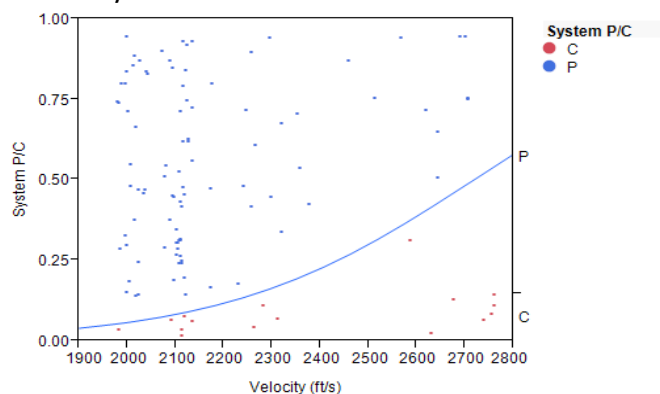
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	6.40733	1	12.81466	0.0003
Full	39.214381			
Reduced	45.621711			

RSquare (U)	0.1404
AICc	82.5409
BIC	87.8297
Observations (or Sum Wgts)	110

Measure	Training	Definition
Entropy RSquare	0.1404	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.1951	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.3565	$\sum -Log(\rho[j])/n$
RMSE	0.3251	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2119	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.1091	$\sum (\rho[j] \neq \rho Max)/n$
N	110	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-10.59848	2.5801983	16.87	<.0001
Velocity (ft/s)	0.00390116	0.0011029	12.51	0.0004

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2716.75	2581.97
0.4	2612.815	2497.374
0.3	2499.559	2399.093
0.2	2361.396	2262.046
0.1	2153.527	2001.046
0.05	1961.99	1722.047
0.01	1538.865	1072.286
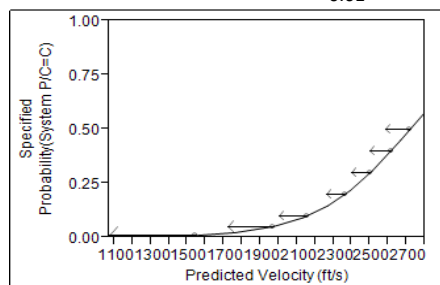
3000 Series 10% Light ESAPI
Shot 1
Threat Y - Hard
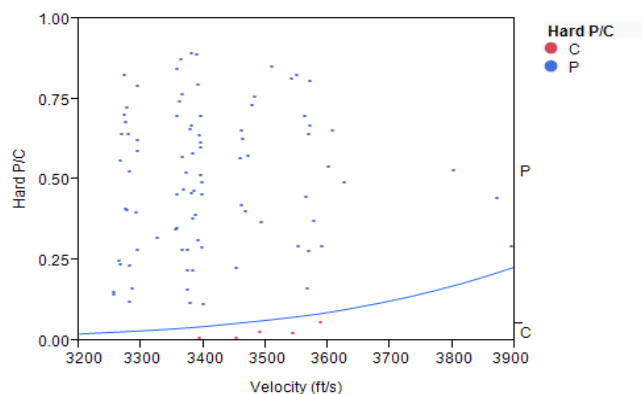
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	0.752555	1	1.505109	0.2199
Full	18.781328			
Reduced	19.533883			

RSquare (U)	0.0385
AICc	41.6945
BIC	46.6492
Observations (or Sum Wgts)	94

Measure	Training	Definition
Entropy RSquare	0.0385	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.0467	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.1998	$\sum$ -Log(ρ[j])/n
RMSE	0.2244	$\sqrt{} \sum$(y[j]-ρ[j])²/n
Mean Abs Dev	0.0996	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.0532	$\sum$ (ρ[j]≠ρMax)/n
N	94	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-15.646799	9.8938823	2.5	0.1138
Velocity (ft/s)	0.00370227	0.0028373	1.7	0.1919

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	4226.276	3838.9
0.4	4116.758	3780.8
0.3	3997.417	3715.9
0.2	3851.831	3632.6
0.1	3632.795	3470.3
0.05	3430.969	-1619
0.01	2985.112	-42897.5
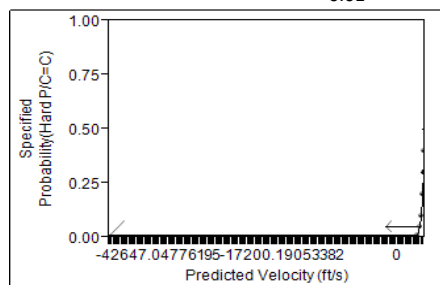
47

3000 Series 10% Light ESAPI
Shot 2
Threat Y - Hard
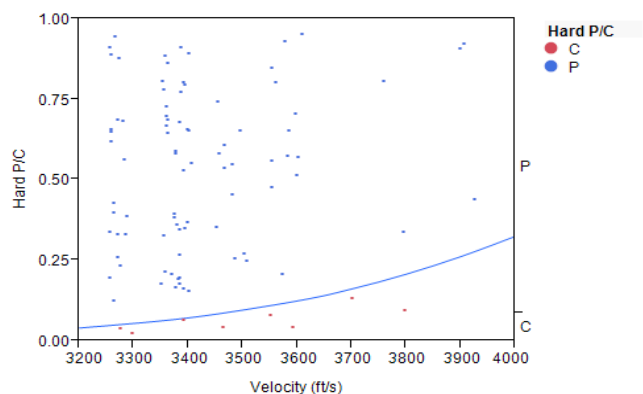
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	1.040004	1	2.080008	0.1492
Full	26.320306			
Reduced	27.36031			

RSquare (U)	0.038
AICc	56.7725
BIC	61.7272
Observations (or Sum Wgts)	94

Measure	Training	Definition
Entropy RSquare	0.038	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.0496	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.28	$\sum -Log(\rho[j])/n$
RMSE	0.2761	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.1519	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.0851	$\sum (\rho[j]\neq\rho Max)/n$
N	94	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-12.920415	7.0648153	3.34	0.0674
Velocity (ft/s)	0.00304769	0.002019	2.28	0.1312

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	4239.412	3876.21
0.4	4106.372	3800.26
0.3	3961.399	3714.82
0.2	3784.545	3601.27
0.1	3518.464	3268.66
0.05	3273.29	1905.43
0.01	2731.673	-1788.87
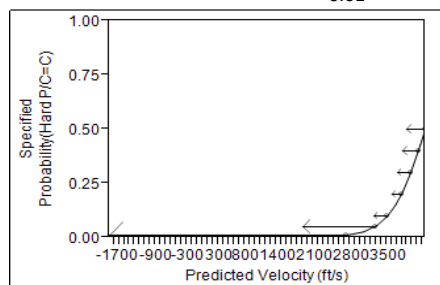
3001 Series 20% Light ESAPI
Shot 1
Threat Y - Hard
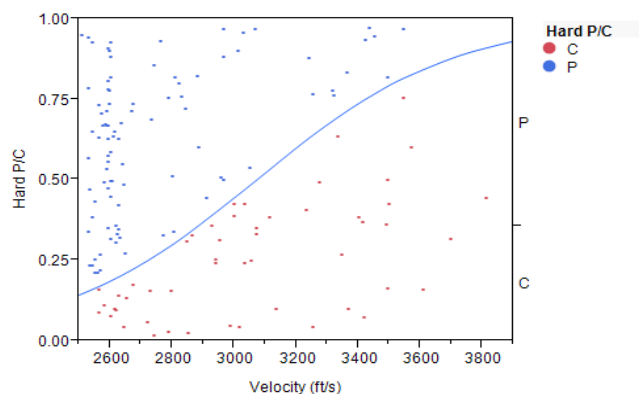
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	15.355555	1	30.71111	<.0001
Full	78.2427			
Reduced	93.598255			

RSquare (U)	0.1641
AICc	160.571
BIC	166.425
Observations (or Sum Wgts)	144

Measure	Training	Definition
Entropy RSquare	0.1641	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.264	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.5434	$\sum -Log(\rho[j])/n$
RMSE	0.4272	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3629	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.2847	$\sum (\rho[j]\neq\rho Max)/n$
N	144	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-9.6388923	1.8296143	27.75	<.0001
Velocity (ft/s)	0.00313862	0.0006309	24.75	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3071.06	2986.279
0.4	2941.874	2861.183
0.3	2801.101	2708.806
0.2	2629.371	2502.024
0.1	2371	2169.477
0.05	2132.929	1854.846
0.01	1607.003	1151.665
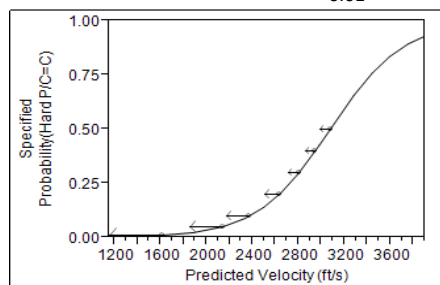
49

3001 Series 20% Light ESAPI
Shot 2
Threat Y - Hard
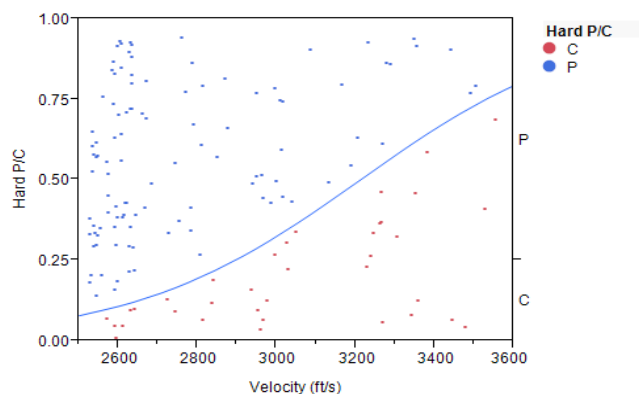
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	13.47312	1	26.94624	<.0001
Full	67.503141			
Reduced	80.976261			

RSquare (U)	0.1664
AICc	139.091
BIC	144.946
Observations (or Sum Wgts)	144

Measure	Training	Definition
Entropy RSquare	0.1664	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2527	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.4688	$\sum -Log(\rho[j])/n$
RMSE	0.3904	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3028	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.2014	$\sum (\rho[j]\neq\rho Max)/n$
N	144	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-11.114609	2.1297213	27.24	<.0001
Velocity (ft/s)	0.00346126	0.0007204	23.08	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3211.148	3118.201
0.4	3094.004	3011.856
0.3	2966.353	2885.008
0.2	2810.63	2709.389
0.1	2576.343	2414.014
0.05	2360.463	2128.451
0.01	1883.561	1485.299
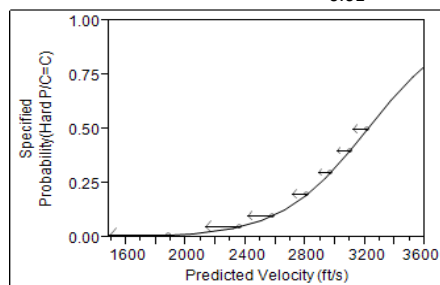
3002 Series 30% Light ESAPI
Shot 1
Threat Y - Hard
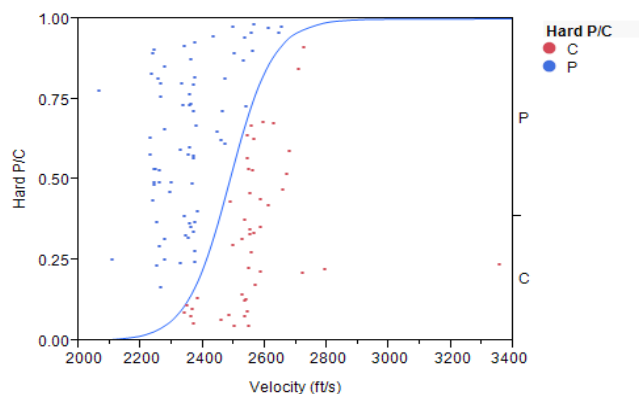
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	31.176223	1	62.35245	<.0001
Full	48.218429			
Reduced	79.394652			

RSquare (U)	0.3927
AICc	100.54
BIC	105.995
Observations (or Sum Wgts)	119

Measure	Training	Definition
Entropy RSquare	0.3927	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.5536	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.4052	$\sum$ -Log(ρ[j])/n
RMSE	0.3589	$\sqrt{}$ $\sum$(y[j]-ρ[j])²/n
Mean Abs Dev	0.2573	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.1681	$\sum$ (ρ[j]≠ρMax)/n
N	119	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-35.688094	6.1751066	33.4	<.0001
Velocity (ft/s)	0.01435927	0.0024979	33.05	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2485.369	2462.351
0.4	2457.132	2432.701
0.3	2426.362	2398.342
0.2	2388.826	2354.161
0.1	2332.351	2284.928
0.05	2280.314	2219.674
0.01	2165.359	2073.555
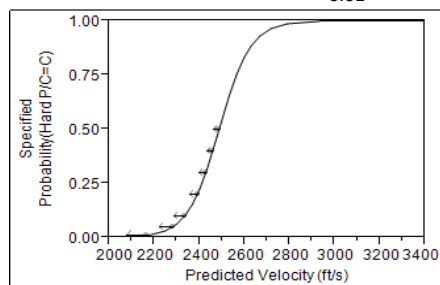
3002 Series 30% Light ESAPI
Shot 2
Threat Y - Hard
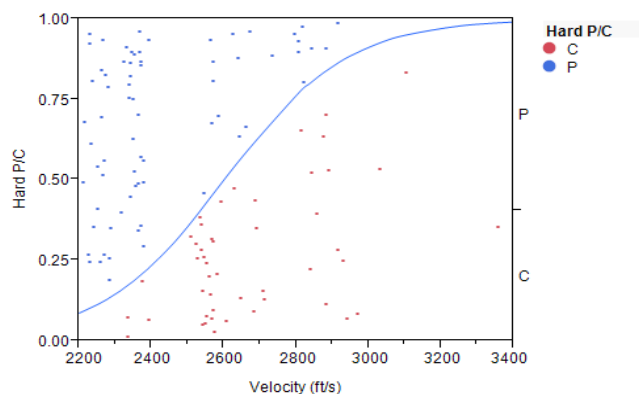
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	18.978997	1	37.95799	<.0001
Full	61.268779			
Reduced	80.247776			

RSquare (U)	0.2365	
AICc	126.641	
BIC	132.096	
Observations (or Sum Wgts)	119	

Measure	Training	Definition
Entropy RSquare	0.2365	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.3689	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.5149	$\sum -Log(\rho[j])/n$
RMSE	0.4181	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3447	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.3277	$\sum (\rho[j]\neq\rho Max)/n$
N	119	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-15.283373	2.922738	27.34	<.0001
Velocity (ft/s)	0.00587651	0.001149	26.16	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2600.758	2551.817
0.4	2531.76	2481.023
0.3	2456.574	2396.374
0.2	2364.853	2284.882
0.1	2226.858	2108.525
0.05	2099.705	1942.246
0.01	1818.81	1570.605
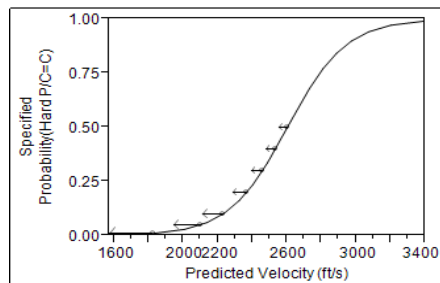
52

3003 Series 40% Light ESAPI
Shot 1
Threat Y - Hard
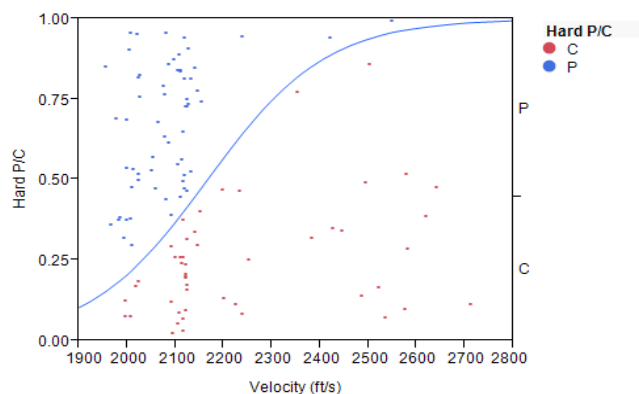
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	13.804766	1	27.60953	<.0001
Full	61.785574			
Reduced	75.59034			

RSquare (U)	0.1826	
AICc	127.683	
BIC	132.972	
Observations (or Sum Wgts)	110	

Measure	Training	Definition
Entropy RSquare	0.1826	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2972	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.5617	$\sum -Log(\rho[j])/n$
RMSE	0.4349	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3813	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.2818	$\sum (\rho[j]\neq\rho Max)/n$
N	110	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-17.569572	4.5709855	14.77	0.0001
Velocity (ft/s)	0.00811403	0.0021593	14.12	0.0002

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2165.333	2130.343
0.4	2115.362	2078.686
0.3	2060.909	2011.483
0.2	1994.482	1919.045
0.1	1894.54	1772.076
0.05	1802.451	1634
0.01	1599.015	1326.393
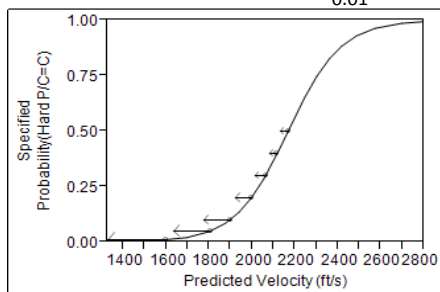
3003 Series 40% Light ESAPI
Shot 2
Threat Y - Hard
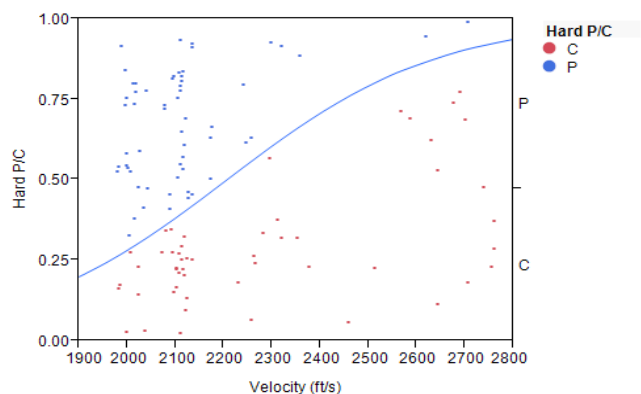
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	9.570754	1	19.14151	<.0001
Full	66.511719			
Reduced	76.082472			

RSquare (U)	0.1258	
AICc	137.136	
BIC	142.424	
Observations (or Sum Wgts)	110	

Measure	Training	Definition
Entropy RSquare	0.1258	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2132	$(1-(L(0)/L(model))^{2/n})/(1-L(0)^{2/n})$
Mean -Log p	0.6047	$\sum -Log(\rho[j])/n$
RMSE	0.4572	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.4184	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.3182	$\sum (\rho[j]\neq\rho Max)/n$
N	110	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-10.031733	2.7031187	13.77	0.0002
Velocity (ft/s)	0.00454893	0.0012503	13.24	0.0003

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2205.294	2146.141
0.4	2116.16	2045.344
0.3	2019.031	1915.43
0.2	1900.543	1742.759
0.1	1722.275	1473.386
0.05	1558.013	1221.866
0.01	1195.141	662.806
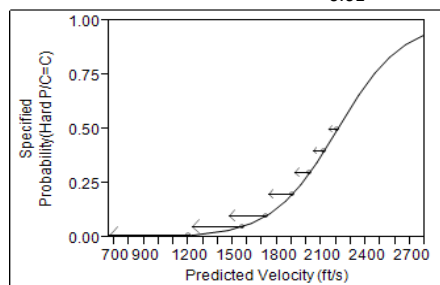
3004 Series 10% Light XSAPI
Shot 1
Threat D - System
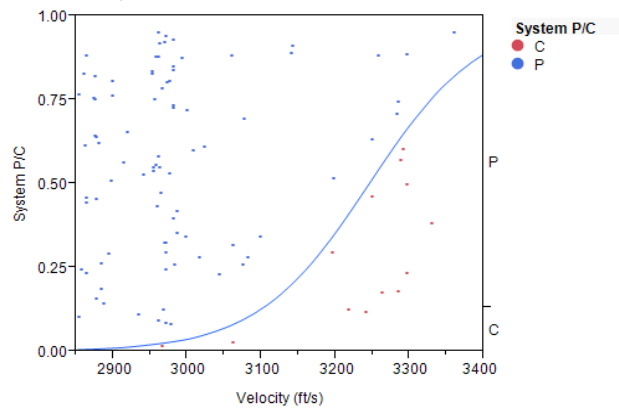
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	16.750941	1	33.50188	<.0001
Full	21.88773			
Reduced	38.638671			

RSquare (U)	0.4335
AICc	47.8992
BIC	52.9858
Observations (or Sum Wgts)	100

Measure	Training	Definition
Entropy RSquare	0.4335	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.5289	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.2189	$\sum$ -Log(ρ[j])/n
RMSE	0.2589	$\sqrt{}$ $\sum$(y[j]-ρ[j])²/n
Mean Abs Dev	0.1318	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.11	$\sum$ (ρ[j]≠ρMax)/n
N	100	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-43.03763	9.4068239	20.93	<.0001
Velocity (ft/s)	0.0132631	0.0029593	20.09	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3244.918	3205.742
0.4	3214.347	3176.123
0.3	3181.034	3141.551
0.2	3140.396	3095.743
0.1	3079.254	3020.38
0.05	3022.916	2946.64
0.01	2898.459	2777.579
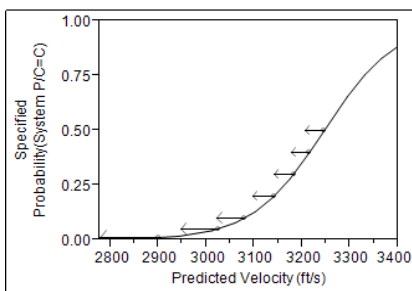
3004 Series 10% Light XSAPI
Shot 2
Threat D - System
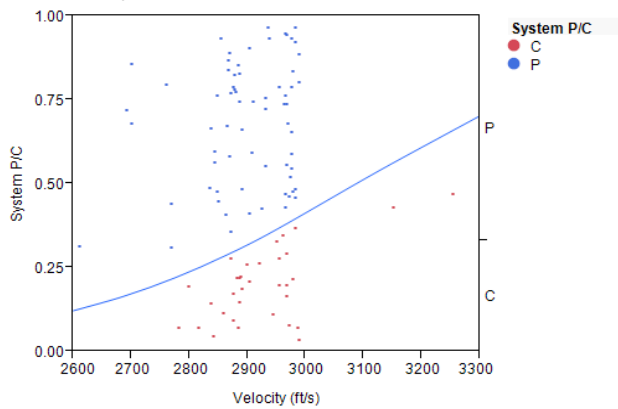
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	1.218485	1	2.43697	0.1185
Full	62.199379			
Reduced	63.417864			

RSquare (U)	0.0192
AICc	128.522
BIC	133.609
Observations (or Sum Wgts)	100

Measure	Training	Definition
Entropy RSquare	0.0192	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.0335	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.622	∑ -Log(ρ[j])/n
RMSE	0.4646	√ ∑(y[j]-ρ[j])²/n
Mean Abs Dev	0.4317	∑ |y[j]-ρ[j]|/n
Misclassification Rate	0.31	∑ (ρ[j]≠ρMax)/n
N	100	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSc
Intercept	-12.51245	7.8793019	2.52	0.1123
Velocity (ft/s)	0.0040533	0.0027007	2.25	0.1334

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3086.968	2992.32
0.4	2986.935	2918.39
0.3	2877.93	2584.5
0.2	2744.953	1678.84
0.1	2544.887	261.28
0.05	2360.541	-1050.21
0.01	1953.298	-3950.72
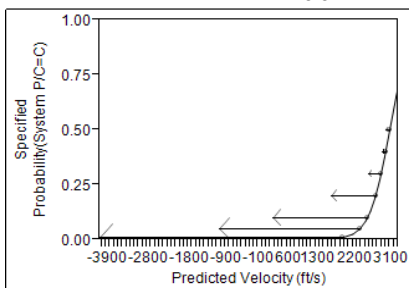
3005 Series 20% Light XSAPI
Shot 1
Threat D - System
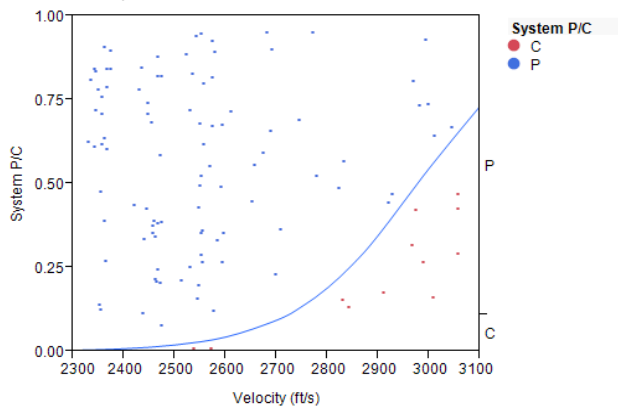
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	14.182361	1	28.36472	<.0001
Full	23.724786			
Reduced	37.907148			

RSquare (U)	0.3741
AICc	51.5617
BIC	56.8505
Observations (or Sum Wgts)	110

Measure	Training	Definition
Entropy RSquare	0.3741	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.4564	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.2157	∑ -Log(ρ[j])/n
RMSE	0.2543	√ ∑(y[j]-ρ[j])²/n
Mean Abs Dev	0.1286	∑ |y[j]-ρ[j]|/n
Misclassification Rate	0.1091	∑ (ρ[j]≠ρMax)/n
N	110	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-24.37707	5.4679796	19.88	<.0001
Velocity (ft/s)	0.0081888	0.0019231	18.13	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2976.867	2913.13
0.4	2927.352	2867.264
0.3	2873.397	2813.633
0.2	2807.576	2741.629
0.1	2708.547	2620.137
0.05	2617.299	2499.149
0.01	2415.722	2219.752
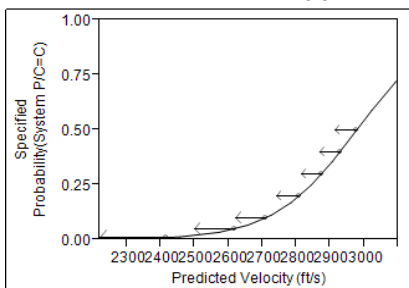
3005 Series 20% Light XSAPI
Shot 2
Threat D - System
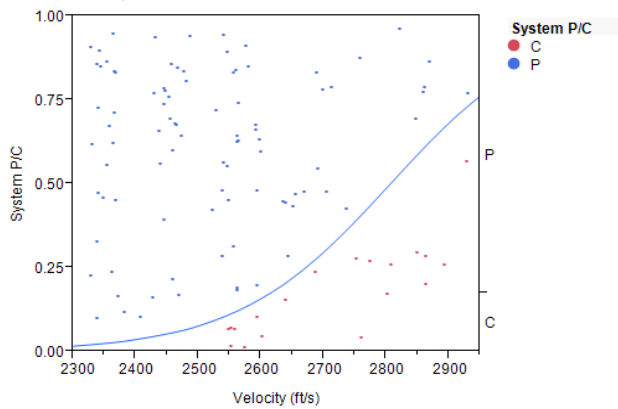
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	11.712923	1	23.42585	<.0001
Full	38.907362			
Reduced	50.620285			

RSquare (U)	0.2314
AICc	81.9269
BIC	87.2157
Observations (or Sum Wgts)	110

Measure	Training	Definition
Entropy RSquare	0.2314	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.3188	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.3537	$\sum -Log(\rho[j])/n$
RMSE	0.3368	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2219	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.1727	$\sum (\rho[j]\neq\rho Max)/n$
N	110	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-22.77915	5.1154565	19.83	<.0001
Velocity (ft/s)	0.0081167	0.0019197	17.88	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2806.44	2752.539
0.4	2756.486	2708.229
0.3	2702.052	2656.029
0.2	2635.646	2584.087
0.1	2535.738	2458.989
0.05	2443.679	2334.018
0.01	2240.312	2047.94
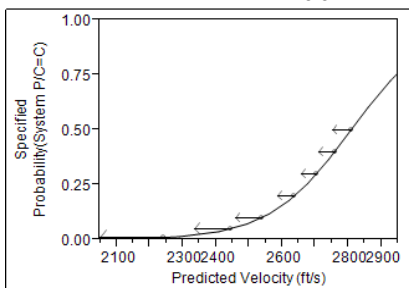
3006 Series 30% Light XSAPI
Shot 1
Threat D - System
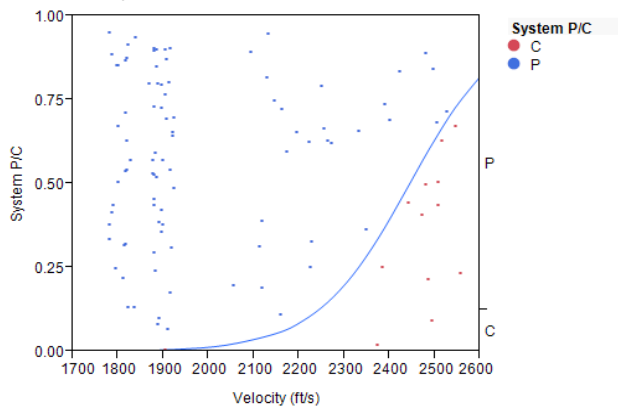
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	19.192274	1	38.38455	<.0001
Full	20.124672			
Reduced	39.316946			

RSquare (U)	0.4881
AICc	44.367
BIC	49.5573
Observations (or Sum Wgts)	105

Measure	Training	Definition
Entropy RSquare	0.4881	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.5809	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.1917	∑ -Log(ρ[j])/n
RMSE	0.2326	√ ∑(y[j]-ρ[j])²/n
Mean Abs Dev	0.1145	∑ |y[j]-ρ[j]|/n
Misclassification Rate	0.0762	∑ (ρ[j]≠ρMax)/n
N	105	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-23.71587	6.0390771	15.42	<.0001
Velocity (ft/s)	0.0097051	0.0025284	14.73	0.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2443.659	2390.814
0.4	2401.88	2347.763
0.3	2356.354	2295.961
0.2	2300.816	2226.155
0.1	2217.259	2111.884
0.05	2140.267	2001.555
0.01	1970.182	1751.374
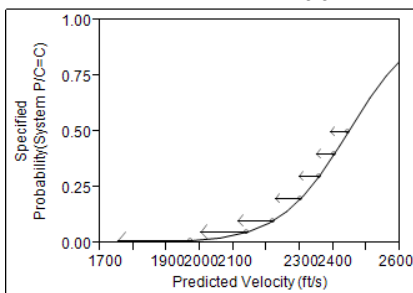
59

3006 Series 30% Light XSAPI
Shot 2
Threat D - System
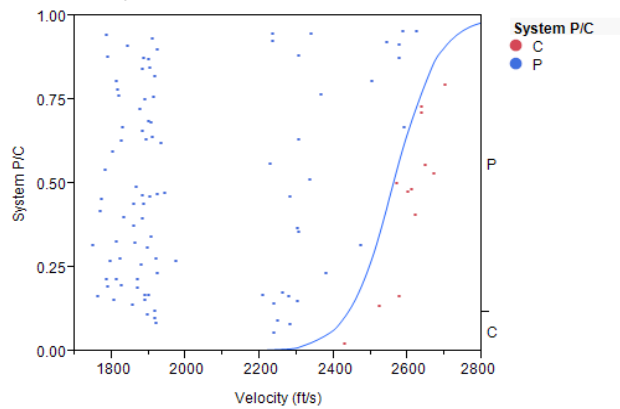
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	24.431804	1	48.86361	<.0001
Full	12.8834			
Reduced	37.315204			

RSquare (U)	0.6547	
AICc	29.8844	
BIC	35.0747	
Observations (or Sum Wgts)	105	

Measure	Training	Definition
Entropy RSquare	0.6547	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.7314	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.1227	$\sum -Log(\rho[j])/n$
RMSE	0.203	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.0811	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.0667	$\sum (\rho[j]\neq\rho Max)/n$
N	105	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-42.11946	14.909305	7.98	0.0047
Velocity (ft/s)	0.0164534	0.0058105	8.02	0.0046

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2559.923	2515.593
0.4	2535.279	2481.412
0.3	2508.426	2439.955
0.2	2475.667	2385.609
0.1	2426.38	2299.894
0.05	2380.966	2218.962
0.01	2280.642	2037.571
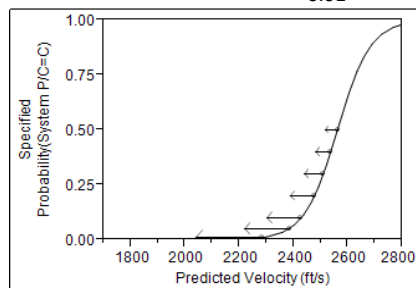
3007 Series 40% Light XSAPI
Shot 1
Threat D - System
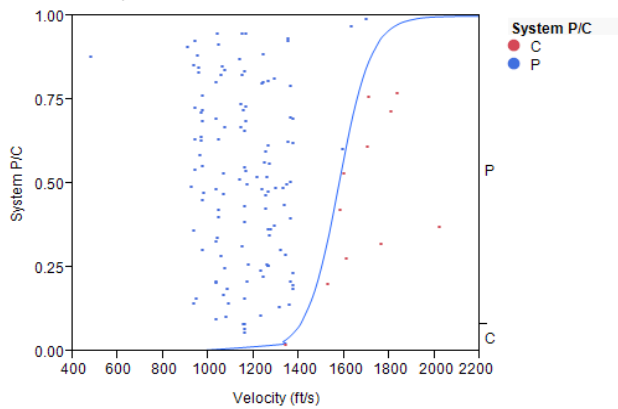
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	26.55085	1	53.1017	<.0001
Full	11.65415			
Reduced	38.204999			

RSquare (U)	0.695
AICc	27.3985
BIC	33.1336
Observations (or Sum Wgts)	136

Measure	Training	Definition
Entropy RSquare	0.695	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.752	$(1-(L(0)/L(model))^{\wedge}(2/n))/(1-L(0)^{\wedge}(2/n))$
Mean -Log p	0.0857	$\sum -Log(\rho[j])/n$
RMSE	0.1605	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.0488	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.0368	$\sum (\rho[j]\neq\rho Max)/n$
N	136	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSc
Intercept	-22.19016	5.1611244	18.49	<.0001
Velocity (ft/s)	0.0140884	0.0034102	17.07	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1575.064	1523.107
0.4	1546.284	1494.567
0.3	1514.923	1461.604
0.2	1476.665	1418.515
0.1	1419.104	1348.133
0.05	1366.067	1278.847
0.01	1248.901	1117.804
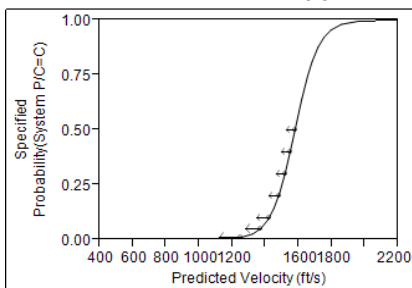
3007 Series 40% Light XSAPI
Shot 2
Threat D - System
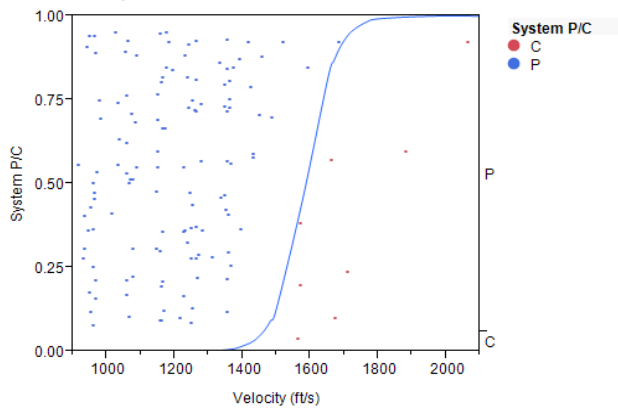
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	23.570927	1	47.14185	<.0001
Full	6.854732			
Reduced	30.425658			

RSquare (U)	0.7747
AICc	17.7997
BIC	23.5348
Observations (or Sum Wgts)	136

Measure	Training	Definition
Entropy RSquare	0.7747	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.812	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.0504	$\sum -Log(\rho[j])/n$
RMSE	0.1289	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.0311	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.0368	$\sum (\rho[j]\neq\rho Max)/n$
N	136	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSc
Intercept	-35.29376	11.839947	8.89	0.0029
Velocity (ft/s)	0.0222774	0.0076126	8.56	0.0034

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1584.286	1542.914
0.4	1566.085	1522.919
0.3	1546.252	1498.791
0.2	1522.057	1465.992
0.1	1485.655	1411.017
0.05	1452.114	1356.566
0.01	1378.017	1230.414
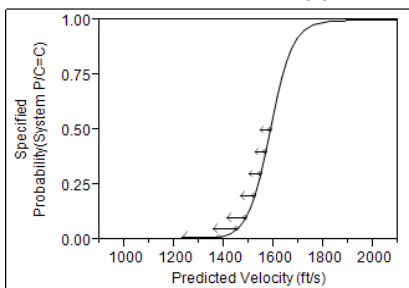
3004 Series 10% Light XSAPI
Shot 1
Threat D - Hard
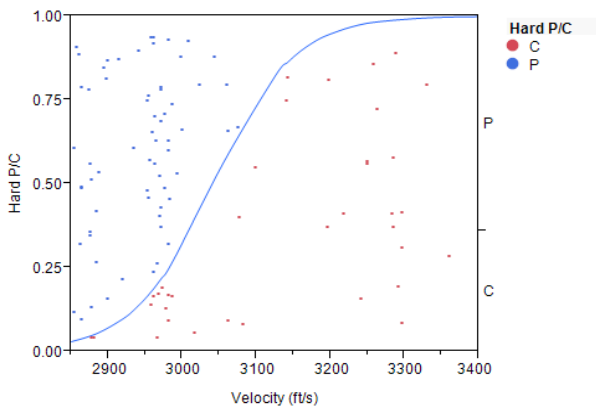
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	28.505194	1	57.01039	<.0001
Full	36.836625			
Reduced	65.341819			

RSquare (U)	0.4362
AICc	77.797
BIC	82.8836
Observations (or Sum Wgts)	100

Measure	Training	Definition
Entropy RSquare	0.4362	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.5958	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.3684	$\sum$ -Log(ρ[j])/n
RMSE	0.3389	$\sqrt{}$ $\sum$(y[j]-ρ[j])²/n
Mean Abs Dev	0.2299	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.16	$\sum$ (ρ[j]≠ρMax)/n
N	100	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-55.50741	12.391713	20.07	<.0001
Velocity (ft/s)	0.0182512	0.0041414	19.42	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3041.296	3018.937
0.4	3019.08	2998.142
0.3	2994.872	2973.381
0.2	2965.34	2939.58
0.1	2920.908	2882.957
0.05	2879.968	2827.749
0.01	2789.526	2702.424
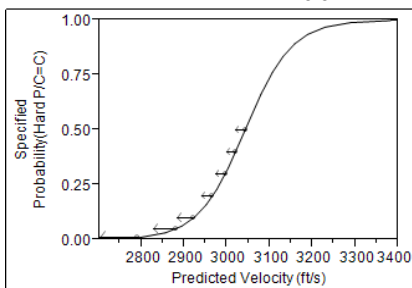
3004 Series 10% Light XSAPI
Shot 2
Threat D - Hard
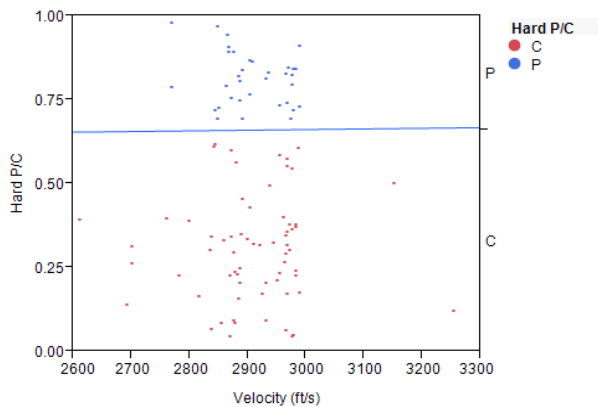
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	0.000604	1	0.001209	0.9723
Full	64.102943			
Reduced	64.103548			

RSquare (U)	0
AICc	132.33
BIC	137.416
Observations (or Sum Wgts)	100

Measure	Training	Definition
Entropy RSquare	0	1-Loglike(model)/Loglike(0)
Generalized RSquare	0	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.641	$\sum -\text{Log}(\rho[j])/n$
RMSE	0.4737	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.4488	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.34	$\sum (\rho[j] \neq \rho\text{Max})/n$
N	100	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	0.4130184	7.2019367	0	0.9543
Velocity (ft/s)	8.608E-05	0.0024761	0	0.9723

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	-4798	.
0.4	-9508.3	.
0.3	-14641.1	.
0.2	-20902.7	.
0.1	-30323.3	.
0.05	-39003.7	.
0.01	-58179.7	.
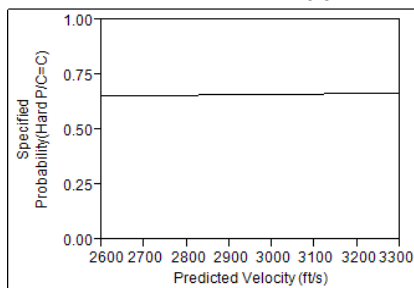
3005 Series 20% Light XSAPI
Shot 1
Threat D - Hard
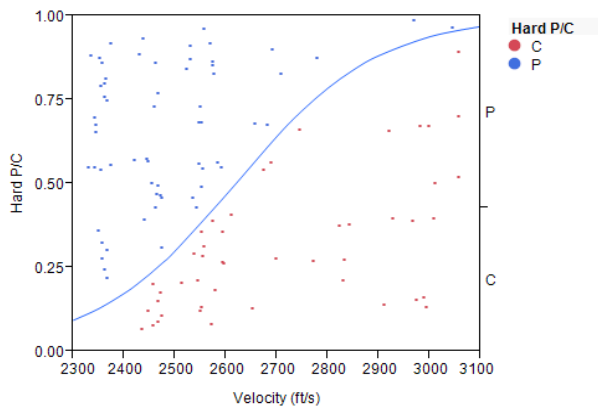
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	18.412719	1	36.82544	<.0001
Full	56.665696			
Reduced	75.078415			

RSquare (U)	0.2452
AICc	117.444
BIC	122.732
Observations (or Sum Wgts)	110

Measure	Training	Definition
Entropy RSquare	0.2452	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.3821	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.5151	$\sum -Log(\rho[j])/n$
RMSE	0.4131	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3415	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.2727	$\sum (\rho[j]\neq\rho Max)/n$
N	110	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-18.70871	3.9016201	22.99	<.0001
Velocity (ft/s)	0.007146	0.0015229	22.02	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2618.053	2576.112
0.4	2561.313	2518.321
0.3	2499.484	2448.155
0.2	2424.058	2354.458
0.1	2310.578	2205.215
0.05	2206.015	2064.233
0.01	1975.022	1748.997
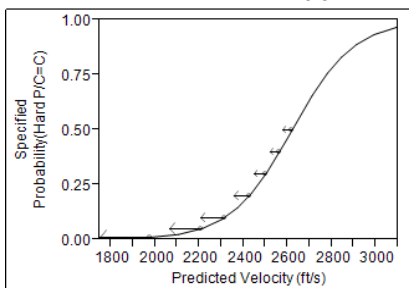
3005 Series 20% Light XSAPI
Shot 2
Threat D - Hard
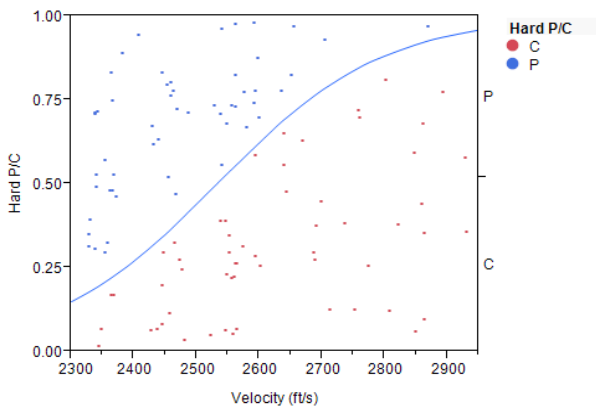
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	13.837069	1	27.67414	<.0001
Full	62.336377			
Reduced	76.173447			

RSquare (U)	0.1817	
AICc	128.785	
BIC	134.074	
Observations (or Sum Wgts)	110	

Measure	Training	Definition
Entropy RSquare	0.1817	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2967	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.5667	$\sum -Log(\rho[j])/n$
RMSE	0.4405	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3868	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.3182	$\sum (\rho[j]\neq\rho Max)/n$
N	110	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-19.02458	4.2982581	19.59	<.0001
Velocity (ft/s)	0.0075127	0.0016967	19.6	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2532.328	2493.569
0.4	2478.357	2431.278
0.3	2419.546	2356.829
0.2	2347.801	2261.056
0.1	2239.859	2112.755
0.05	2140.399	1974.336
0.01	1920.68	1666.442
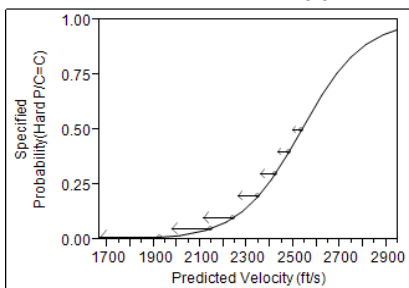
3006 Series 30% Light XSAPI
Shot 1
Threat D - Hard
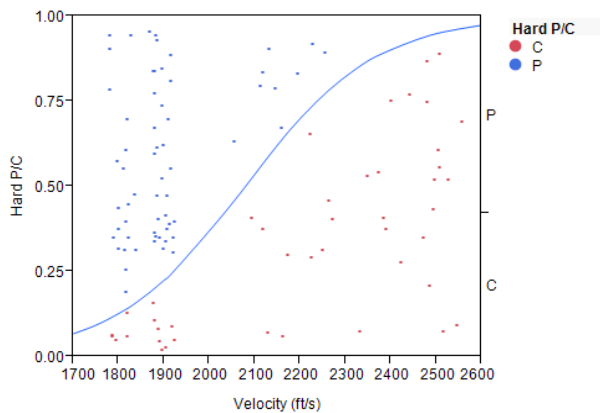
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	23.469289	1	46.93858	<.0001
Full	47.928898			
Reduced	71.398187			

RSquare (U)	0.3287	
AICc	99.9754	
BIC	105.166	
Observations (or Sum Wgts)	105	

Measure	Training	Definition
Entropy RSquare	0.3287	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.4849	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.4565	$\sum$ -Log(ρ[j])/n
RMSE	0.3833	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2919	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.2	$\sum$ (ρ[j]$\neq\rho$Max)/n
N	105	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-14.41498	2.6471484	29.65	<.0001
Velocity (ft/s)	0.0069377	0.0013168	27.76	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2077.769	2029.596
0.4	2019.325	1971.121
0.3	1955.639	1902.224
0.2	1877.949	1811.473
0.1	1761.062	1666.32
0.05	1653.359	1528.239
0.01	1415.43	1217.938
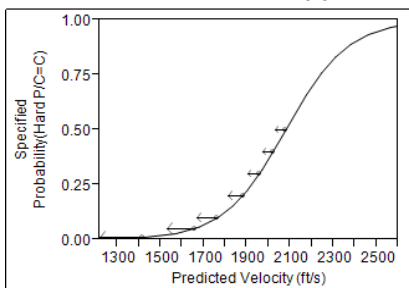
3006 Series 30% Light XSAPI
Shot 2
Threat D - Hard
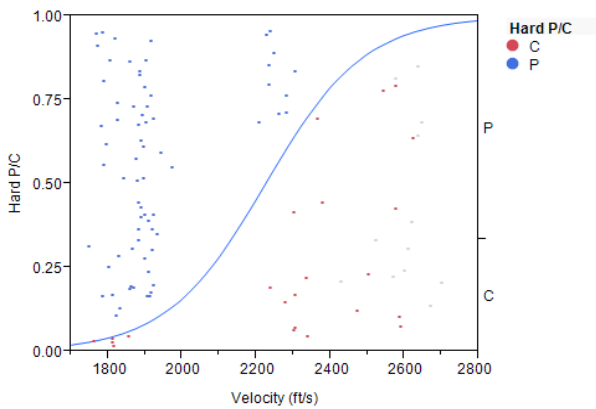
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	33.09574	1	66.19148	<.0001
Full	33.738248			
Reduced	66.833988			

RSquare (U)	0.4952
AICc	71.5941
BIC	76.7844
Observations (or Sum Wgts)	105

Measure	Training	Definition
Entropy RSquare	0.4952	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.6495	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.3213	$\sum -Log(\rho[j])/n$
RMSE	0.297	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.183	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.1333	$\sum (\rho[j]\neq\rho Max)/n$
N	105	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-16.59518	2.7766438	35.72	<.0001
Velocity (ft/s)	0.0074622	0.0012813	33.92	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2223.91	2169.01
0.4	2169.574	2114.12
0.3	2110.364	2051.124
0.2	2038.134	1970.001
0.1	1929.461	1841.36
0.05	1829.328	1718.644
0.01	1608.121	1441.266
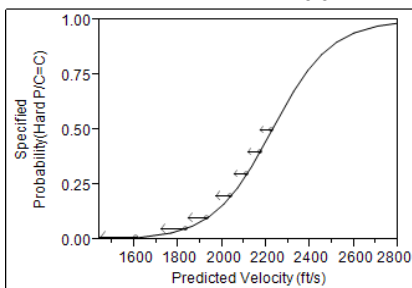
3007 Series 40% Light XSAPI
Shot 1
Threat D - Hard
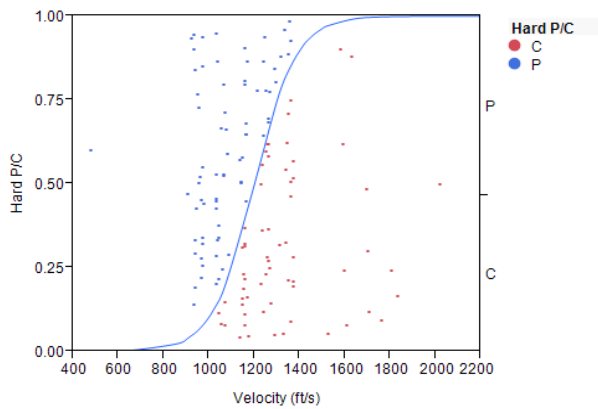
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	32.913239	1	65.82648	<.0001
Full	60.986799			
Reduced	93.900037			

RSquare (U)	0.3505
AICc	126.064
BIC	131.799
Observations (or Sum Wgts)	136

Measure	Training	Definition
Entropy RSquare	0.3505	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.5125	$(1-(L(0)/L(model))^{2/n})/(1-L(0)^{2/n})$
Mean -Log p	0.4484	$\sum -Log(\rho[j])/n$
RMSE	0.3895	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2983	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.2426	$\sum (\rho[j]\neq\rho Max)/n$
N	136	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-12.97775	2.2738514	32.57	<.0001
Velocity (ft/s)	0.0108256	0.0019152	31.95	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1198.801	1172.07
0.4	1161.347	1132.453
0.3	1120.533	1086.154
0.2	1070.744	1026.504
0.1	995.835	933.325
0.05	926.813	845.82
0.01	774.333	650.432
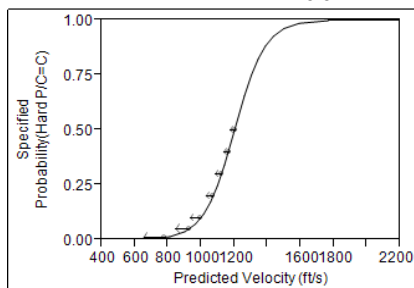
3007 Series 40% Light XSAPI
Shot 2
Threat D - Hard
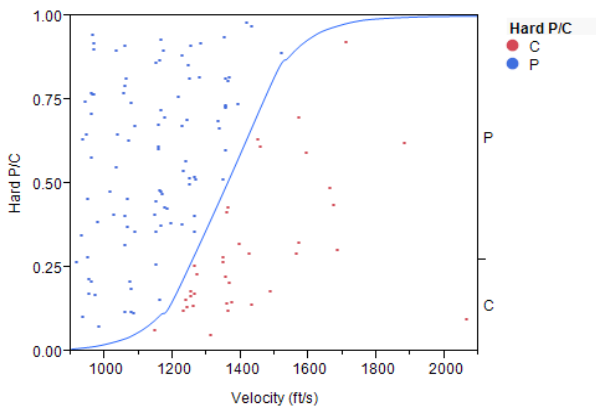
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	29.261809	1	58.52362	<.0001
Full	50.338428			
Reduced	79.600237			

RSquare (U)	0.3676
AICc	104.767
BIC	110.502
Observations (or Sum Wgts)	136

Measure	Training	Definition
Entropy RSquare	0.3676	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.5069	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.3701	$\sum -Log(\rho[j])/n$
RMSE	0.3441	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2363	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.1618	$\sum (\rho[j] \neq \rho Max)/n$
N	136	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSc
Intercept	-14.61208	2.699092	29.31	<.0001
Velocity (ft/s)	0.0107669	0.0020838	26.7	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1357.136	1325.93
0.4	1319.477	1289.607
0.3	1278.441	1246.705
0.2	1228.38	1189.432
0.1	1153.063	1096.364
0.05	1083.663	1007.164
0.01	930.352	806.182
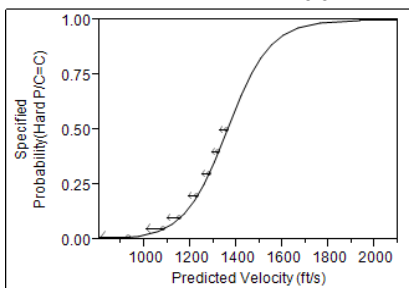
70

3004 Series 10% Light XSAPI
Shot 1
Threat X - System
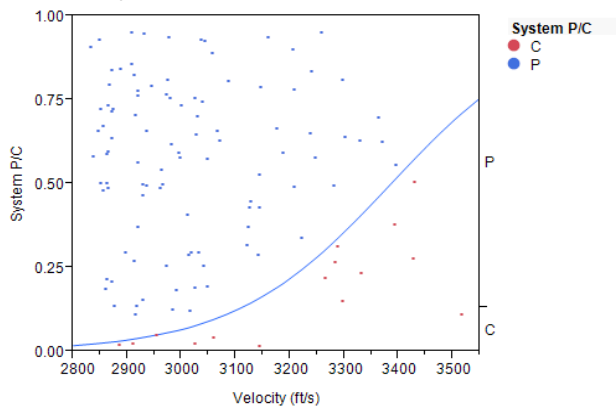
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	8.69724	1	17.39448	<.0001
Full	35.971297			
Reduced	44.668537			

RSquare (U)	0.1947	
AICc	76.0488	
BIC	81.4498	
Observations (or Sum Wgts)	116	

Measure	Training	Definition
Entropy RSquare	0.1947	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2593	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.3101	$\sum$ -Log(ρ[j])/n
RMSE	0.2973	$\sqrt{} \sum$(y[j]-ρ[j])²/n
Mean Abs Dev	0.1804	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.1034	$\sum$ (ρ[j]≠ρMax)/n
N	116	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-23.26017	5.7316225	16.47	<.0001
Velocity (ft/s)	0.0068707	0.0018072	14.45	0.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3385.421	3310.229
0.4	3326.408	3260.778
0.3	3262.101	3203.369
0.2	3183.652	3124.433
0.1	3065.624	2980.085
0.05	2956.87	2828.523
0.01	2716.621	2475.077
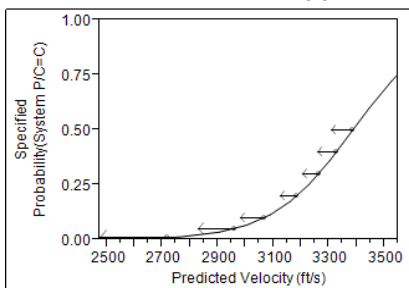
71

3004 Series 10% Light XSAPI
Shot 2
Threat X - System
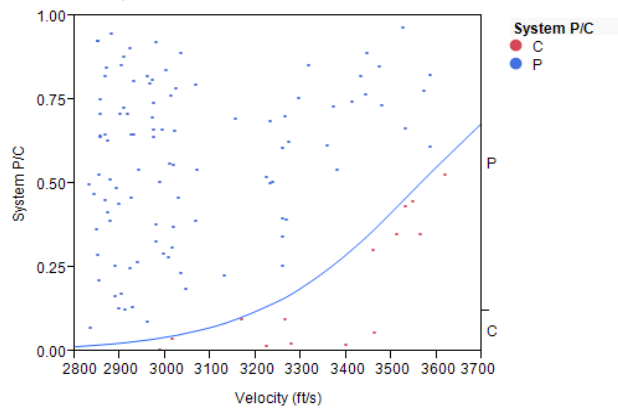
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	9.959779	1	19.91956	<.0001
Full	32.762653			
Reduced	42.722433			

RSquare (U)	0.2331
AICc	69.6315
BIC	75.0325
Observations (or Sum Wgts)	116

Measure	Training	Definition
Entropy RSquare	0.2331	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.3027	$(1-(L(0)/L(model))^{\wedge}(2/n))/(1-L(0)^{\wedge}(2/n))$
Mean -Log p	0.2824	$\sum -Log(\rho[j])/n$
RMSE	0.2938	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.1705	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.1293	$\sum (\rho[j]\neq\rho Max)/n$
N	116	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSc
Intercept	-19.69609	4.6633541	17.84	<.0001
Velocity (ft/s)	0.0055296	0.0014076	15.43	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3561.968	3469.88
0.4	3488.641	3406.94
0.3	3408.737	3333.586
0.2	3311.261	3233.015
0.1	3164.607	3053.27
0.05	3029.476	2867.7
0.01	2730.957	2436.223
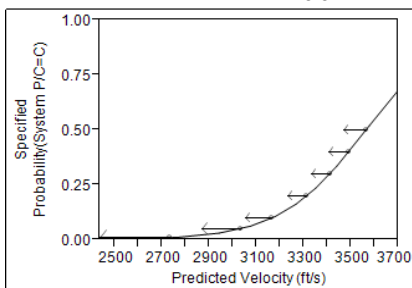
72

3005 Series 20% Light XSAPI
Shot 1
Threat X - System
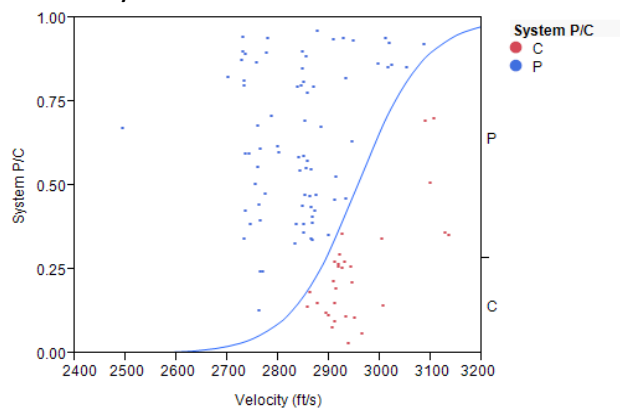
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	15.653377	1	31.30675	<.0001
Full	47.499512			
Reduced	63.152889			

RSquare (U)	0.2479
AICc	99.1155
BIC	104.326
Observations (or Sum Wgts)	106

Measure	Training	Definition
Entropy RSquare	0.2479	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.3673	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.4481	$\sum$ -Log(ρ[j])/n
RMSE	0.3917	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2984	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.2736	$\sum$ (ρ[j]≠ρMax)/n
N	106	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-44.24106	9.9766719	19.66	<.0001
Velocity (ft/s)	0.0149753	0.0034358	19	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2954.26	2930.783
0.4	2927.185	2905.202
0.3	2897.681	2874.124
0.2	2861.689	2831.149
0.1	2807.538	2759.869
0.05	2757.641	2691.306
0.01	2647.415	2536.94
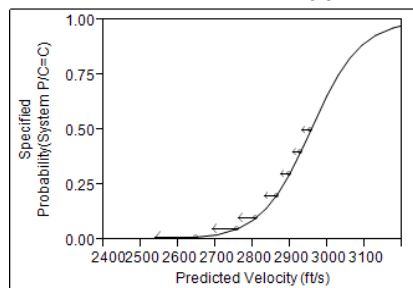
3005 Series 20% Light XSAPI
Shot 2
Threat X - System
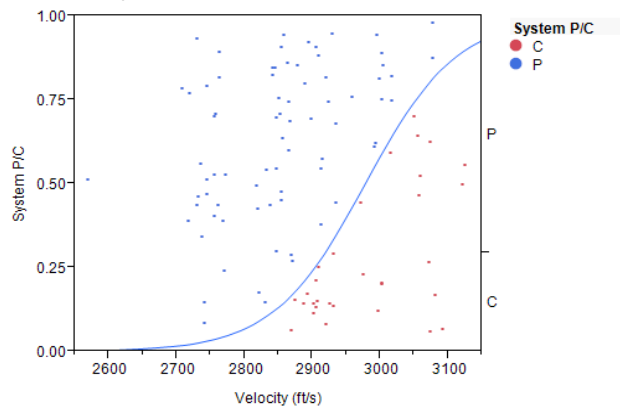
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	18.103378	1	36.20676	<.0001
Full	45.955954			
Reduced	64.059332			

RSquare (U)	0.2826
AICc	96.0284
BIC	101.239
Observations (or Sum Wgts)	106

Measure	Training	Definition
Entropy RSquare	0.2826	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.4125	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.4335	$\sum -Log(\rho[j])/n$
RMSE	0.3835	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.2865	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.2547	$\sum (\rho[j]\neq\rho Max)/n$
N	106	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-43.97036	9.0610472	23.55	<.0001
Velocity (ft/s)	0.0147677	0.0030861	22.9	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2977.462	2954.153
0.4	2950.006	2927.19
0.3	2920.087	2894.946
0.2	2883.589	2851.664
0.1	2828.677	2781.508
0.05	2778.079	2714.481
0.01	2666.303	2563.72
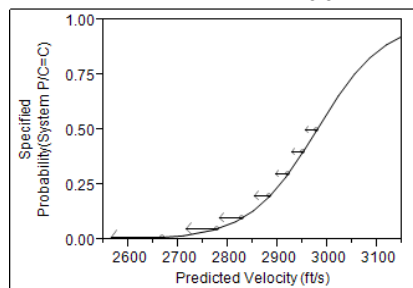
3006 Series 30% Light XSAPI
Shot 1
Threat X - System
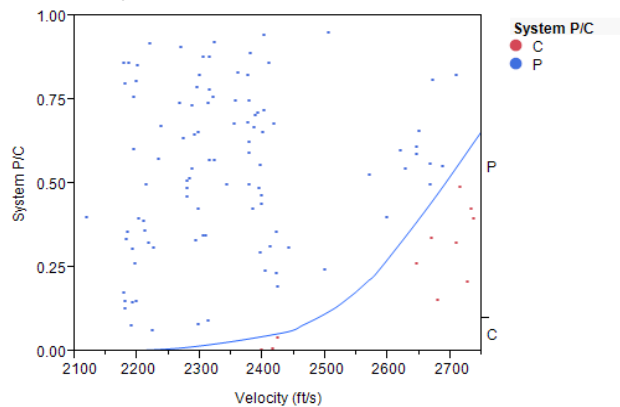
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	13.47485	1	26.9497	<.0001
Full	22.389136			
Reduced	35.863986			

RSquare (U)	0.3757
AICc	48.8894
BIC	54.1973
Observations (or Sum Wgts)	111

Measure	Training	Definition
Entropy RSquare	0.3757	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.4529	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.2017	$\sum -Log(\rho[j])/n$
RMSE	0.2426	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.1191	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.0631	$\sum (\rho[j]\neq\rho Max)/n$
N	111	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-29.23573	6.9154047	17.87	<.0001
Velocity (ft/s)	0.0108712	0.0026732	16.54	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2689.278	2639.972
0.4	2651.981	2605.555
0.3	2611.338	2565.125
0.2	2561.758	2510.459
0.1	2487.164	2417.487
0.05	2418.431	2324.547
0.01	2266.591	2109.705
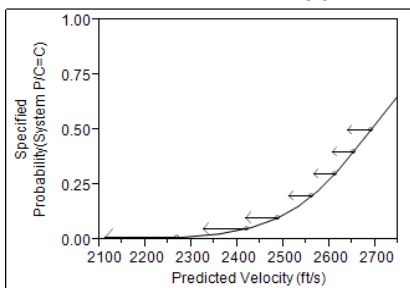
3006 Series 30% Light XSAPI
Shot 2
Threat X - System
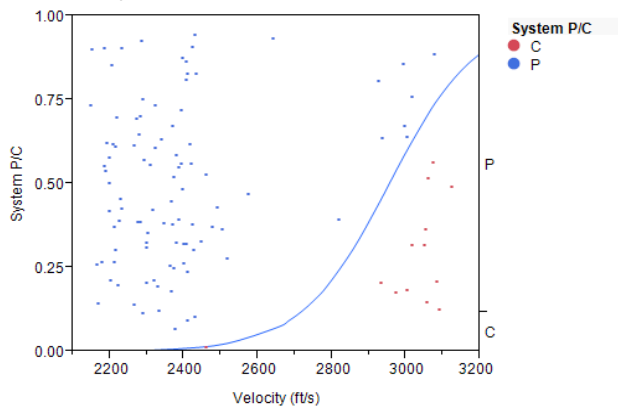
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	23.861139	1	47.72228	<.0001
Full	16.225559			
Reduced	40.086698			

RSquare (U)	0.5952
AICc	36.5622
BIC	41.8702
Observations (or Sum Wgts)	111

Measure	Training	Definition
Entropy RSquare	0.5952	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.6794	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.1462	$\sum -Log(\rho[j])/n$
RMSE	0.2086	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.0888	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.0631	$\sum (\rho[j]\neq\rho Max)/n$
N	111	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-24.89542	6.176679	16.25	<.0001
Velocity (ft/s)	0.0084285	0.0021016	16.08	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2953.731	2883.784
0.4	2905.625	2829.985
0.3	2853.203	2766.849
0.2	2789.254	2684.589
0.1	2693.04	2553.761
0.05	2604.387	2429.055
0.01	2408.541	2147.416
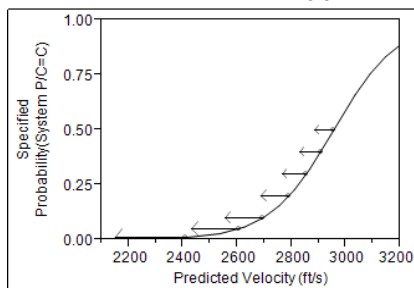
3007 Series 40% Light XSAPI
Shot 1
Threat X - System
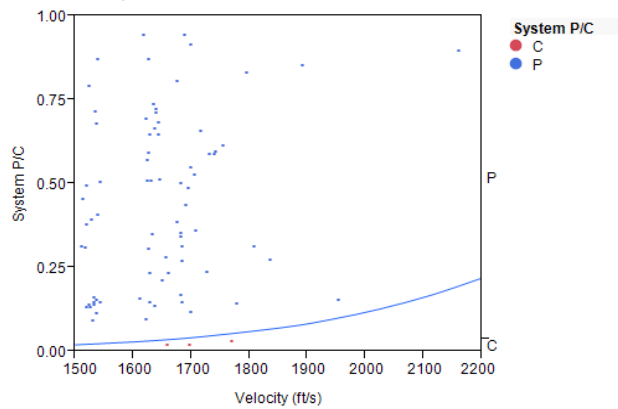
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	0.363519	1	0.727039	0.3938
Full	12.429757			
Reduced	12.793276			

RSquare (U)	0.0284
AICc	29.0154
BIC	33.6236
Observations (or Sum Wgts)	80

Measure	Training	Definition
Entropy RSquare	0.0284	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.0331	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.1554	$\sum$ -Log(ρ[j])/n
RMSE	0.1902	$\sqrt{}$ $\sum$(y[j]-ρ[j])²/n
Mean Abs Dev	0.0718	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.0375	$\sum$ (ρ[j]≠ρMax)/n
N	80	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSc
Intercept	-9.519956	6.8350689	1.94	0.1637
Velocity (ft/s)	0.0037506	0.0040033	0.88	0.3488

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%	Type of CI
0.5	2538.225	2034.617	
0.4	2430.119	1986.443	
0.3	2312.317	1932.805	
0.2	2168.609	1864.389	
0.1	1952.398	1740.893	
0.05	1753.174	1536.633	Wald
0.01	1313.067	.	
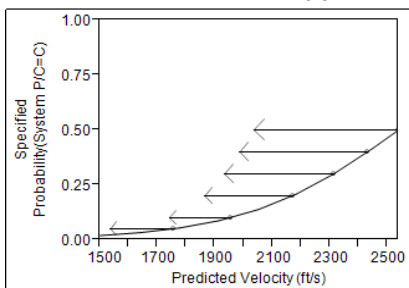
3007 Series 40% Light XSAPI
Shot 2
Threat X - System
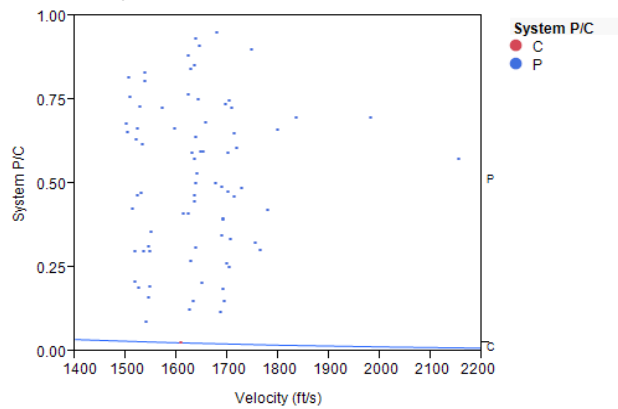
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	0.0234275	1	0.046855	0.8286
Full	9.3291204			
Reduced	9.3525479			

RSquare (U)	0.0025	
AICc	22.8141	
BIC	27.4223	
Observations (or Sum Wgts)	80	

Measure	Training	Definition
Entropy RSquare	0.0025	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.0028	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.1166	$\sum$ -Log(ρ[j])/n
RMSE	0.1561	$\sqrt{}$ $\sum$(y[j]-ρ[j])²/n
Mean Abs Dev	0.0487	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.025	$\sum$ (ρ[j]≠ρMax)/n
N	80	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-1.052809	12.492337	0.01	0.9328
Velocity (ft/s)	-0.001599	0.0076734	0.04	0.8349

For log odds of C/P

Inverse Prediction

Specified Probability(System P/C=C)	Predicted Velocity (ft/s)	Lower 90%	Type of CI
0.5	-658.32	.	
0.4	-404.78	.	
0.3	-128.51	.	
0.2	208.53	.	
0.1	715.6	.	
0.05	1182.84	-1621.73	Wald
0.01	2215	1633.74	
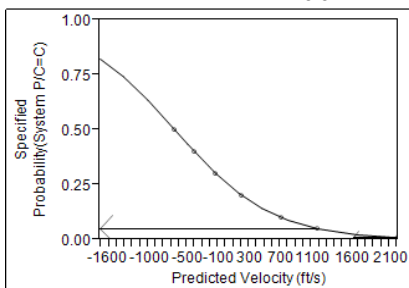
3004 Series 10% Light XSAPI
Shot 1
Threat X - Hard
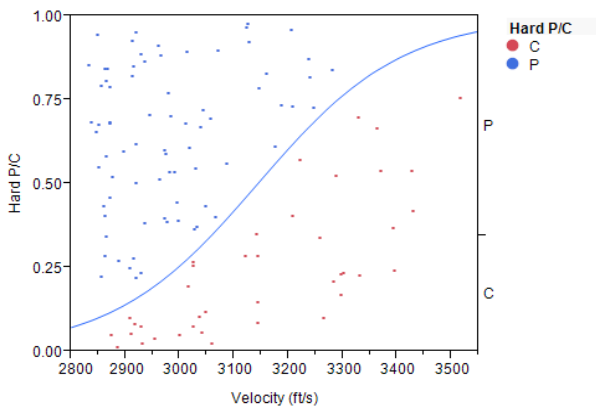
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	15.72287	1	31.44574	<.0001
Full	59.00268			
Reduced	74.72555			

RSquare (U)	0.2104
AICc	122.112
BIC	127.513
Observations (or Sum Wgts)	116

Measure	Training	Definition
Entropy RSquare	0.2104	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.3278	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.5086	$\sum -Log(\rho[j])/n$
RMSE	0.4104	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3348	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.25	$\sum (\rho[j]\neq\rho Max)/n$
N	116	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-23.48983	4.7459987	24.5	<.0001
Velocity (ft/s)	0.0074743	0.001548	23.31	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3142.753	3102.098
0.4	3088.505	3049.094
0.3	3029.391	2985.037
0.2	2957.278	2898.493
0.1	2848.782	2758.7
0.05	2748.81	2625.825
0.01	2527.962	2328.012
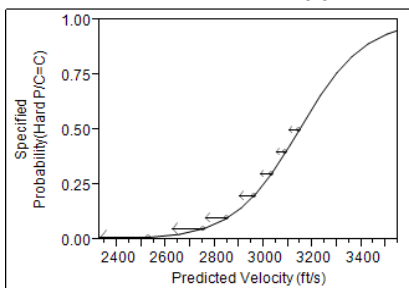
3004 Series 10% Light XSAPI
Shot 2
Threat X - Hard
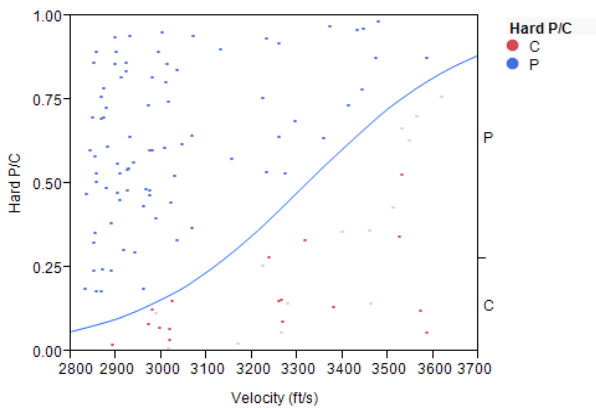
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	15.597693	1	31.19539	<.0001
Full	52.726609			
Reduced	68.324302			

RSquare (U)	0.2283
AICc	109.559
BIC	114.96
Observations (or Sum Wgts)	116

Measure	Training	Definition
Entropy RSquare	0.2283	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.3407	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.4545	$\sum$ -Log(ρ[j])/n
RMSE	0.3856	$\sqrt{}$ $\sum$(y[j]-ρ[j])²/n
Mean Abs Dev	0.2932	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.2414	$\sum$ (ρ[j]$\neq\rho$Max)/n
N	116	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-17.6493	3.4059485	26.85	<.0001
Velocity (ft/s)	0.0053179	0.0010719	24.62	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	3318.835	3255.551
0.4	3242.589	3183.286
0.3	3159.506	3097.428
0.2	3058.151	2981.406
0.1	2905.661	2790.873
0.05	2765.152	2607.655
0.01	2454.752	2194.681
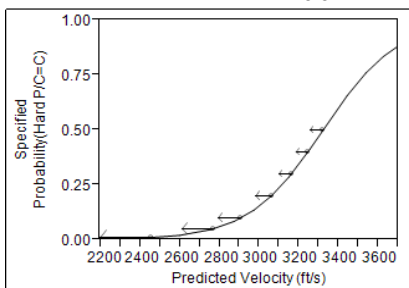
3005 Series 20% Light XSAPI
Shot 1
Threat X - Hard
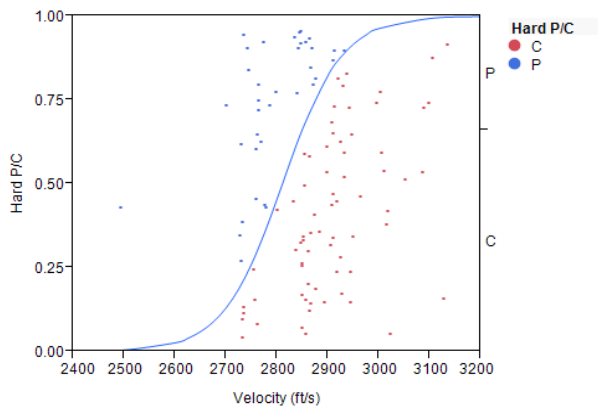
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	18.302036	1	36.60407	<.0001
Full	49.621159			
Reduced	67.923195			

RSquare (U)	0.2695
AICc	103.359
BIC	108.569
Observations (or Sum Wgts)	106

Measure	Training	Definition
Entropy RSquare	0.2695	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.4042	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.4681	$\sum -Log(\rho[j])/n$
RMSE	0.3949	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3095	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.217	$\sum (\rho[j]\neq\rho Max)/n$
N	106	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-48.26411	10.411405	21.49	<.0001
Velocity (ft/s)	0.0171749	0.0036684	21.92	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2810.159	2786.937
0.4	2786.551	2757.802
0.3	2760.825	2724.625
0.2	2729.442	2683.042
0.1	2682.226	2619.362
0.05	2638.72	2560.119
0.01	2542.61	2428.443
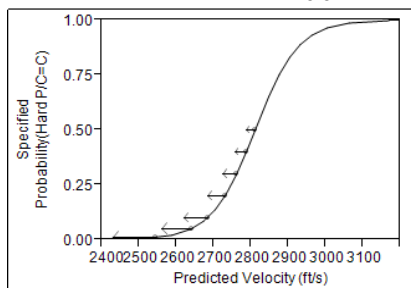
3005 Series 20% Light XSAPI
Shot 2
Threat X - Hard
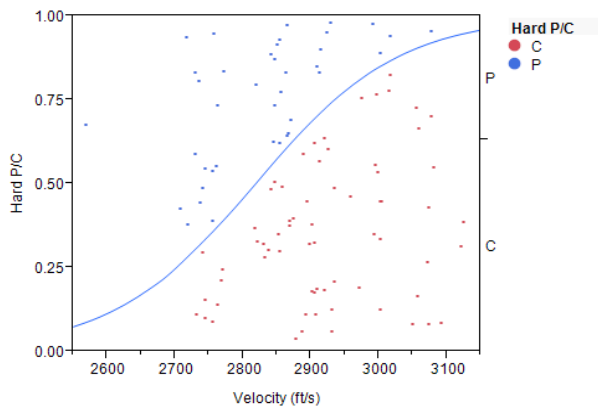
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	10.168668	1	20.33734	<.0001
Full	59.562566			
Reduced	69.731234			

RSquare (U)	0.1458	
AICc	123.242	
BIC	128.452	
Observations (or Sum Wgts)	106	

Measure	Training	Definition
Entropy RSquare	0.1458	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2386	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.5619	$\sum -Log(\rho[j])/n$
RMSE	0.4364	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3811	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.3019	$\sum (\rho[j]\neq\rho Max)/n$
N	106	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-26.60881	6.8623825	15.03	0.0001
Velocity (ft/s)	0.0094429	0.0023949	15.55	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2817.856	2776.05
0.4	2774.917	2718.492
0.3	2728.127	2652.659
0.2	2671.048	2570.347
0.1	2585.171	2444.752
0.05	2506.041	2328.213
0.01	2331.235	2069.684
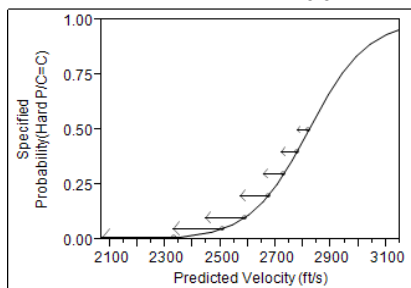
3006 Series 30% Light XSAPI
Shot 1
Threat X - Hard
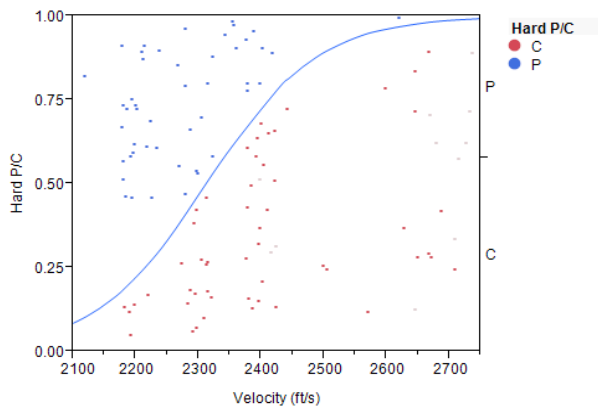
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	19.72581	1	39.45162	<.0001
Full	55.906588			
Reduced	75.632398			

RSquare (U)	0.2608
AICc	115.924
BIC	121.232
Observations (or Sum Wgts)	111

Measure	Training	Definition
Entropy RSquare	0.2608	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.402	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.5037	$\sum -Log(\rho[j])/n$
RMSE	0.4099	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.338	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.2703	$\sum (\rho[j]\neq\rho Max)/n$
N	111	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-25.9286	5.7391429	20.41	<.0001
Velocity (ft/s)	0.0112148	0.0024756	20.52	<.0001

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2311.991	2283.95
0.4	2275.837	2241.912
0.3	2236.44	2192.282
0.2	2188.379	2128.756
0.1	2116.07	2030.479
0.05	2049.443	1938.721
0.01	1902.255	1734.526
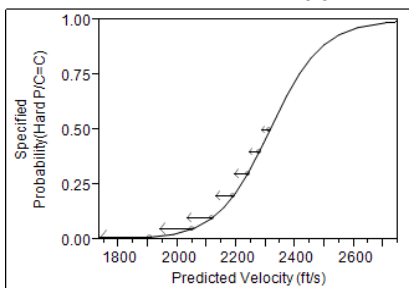
3006 Series 30% Light XSAPI
Shot 2
Threat X - Hard
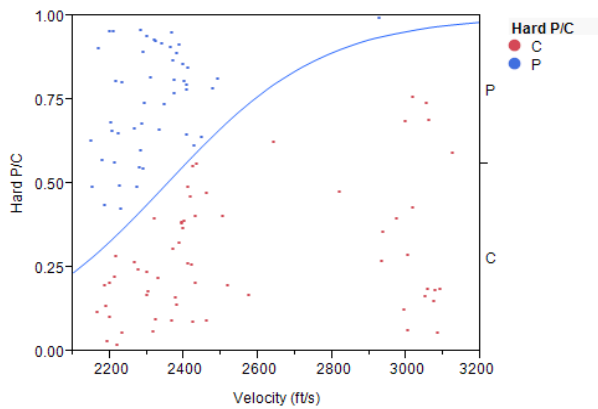
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	12.061402	1	24.1228	<.0001
Full	64.114924			
Reduced	76.176326			

RSquare (U)	0.1583
AICc	132.341
BIC	137.649
Observations (or Sum Wgts)	111

Measure	Training	Definition
Entropy RSquare	0.1583	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2616	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.5776	$\sum$ -Log(ρ[j])/n
RMSE	0.4494	$\sqrt{} \sum$(y[j]-ρ[j])²/n
Mean Abs Dev	0.4033	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.3333	$\sum$ (ρ[j]≠ρMax)/n
N	111	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-11.03873	3.1172726	12.54	0.0004
Velocity (ft/s)	0.0046944	0.0013217	12.61	0.0004

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	2351.475	2288.869
0.4	2265.103	2179.35
0.3	2170.984	2044.929
0.2	2056.166	1872.172
0.1	1883.422	1606.096
0.05	1724.25	1358.579
0.01	1372.621	809.129
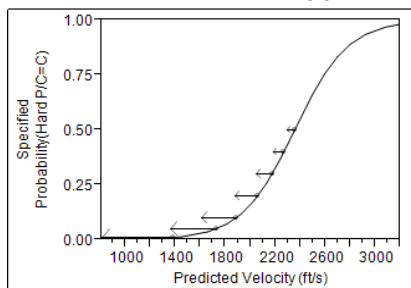
3007 Series 40% Light XSAPI
Shot 1
Threat X - Hard
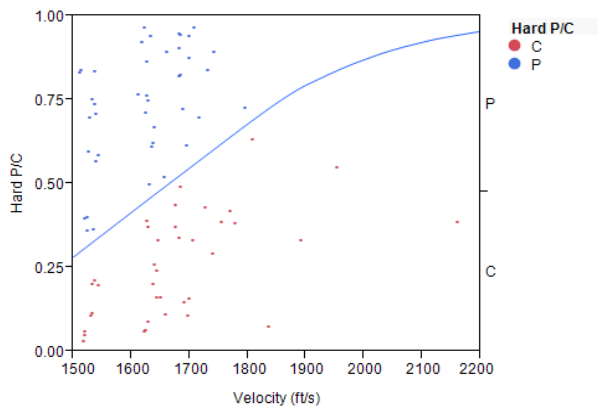
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	2.942565	1	5.88513	0.0153
Full	52.409168			
Reduced	55.351733			

RSquare (U)	0.0532
AICc	108.974
BIC	113.582
Observations (or Sum Wgts)	80

Measure	Training	Definition
Entropy RSquare	0.0532	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.0946	$(1-(L(0)/L(model))^{(2/n)})/(1-L(0)^{(2/n)})$
Mean -Log p	0.6551	$\sum -Log(\rho[j])/n$
RMSE	0.4824	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.4647	$\sum |y[j]-\rho[j]|/n$
Misclassification Rate	0.425	$\sum (\rho[j]\neq\rho Max)/n$
N	80	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-9.46411	4.2594103	4.94	0.0263
Velocity (ft/s)	0.0056858	0.0025874	4.83	0.028

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1664.532	1607.64
0.4	1593.22	1486.94
0.3	1515.511	1315.13
0.2	1420.713	1091.78
0.1	1278.088	749.4
0.05	1146.669	431.96
0.01	856.35	-271.24
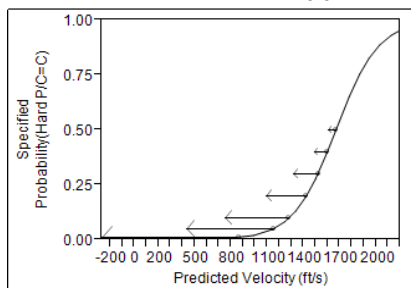
3007 Series 40% Light XSAPI
Shot 2
Threat X - Hard
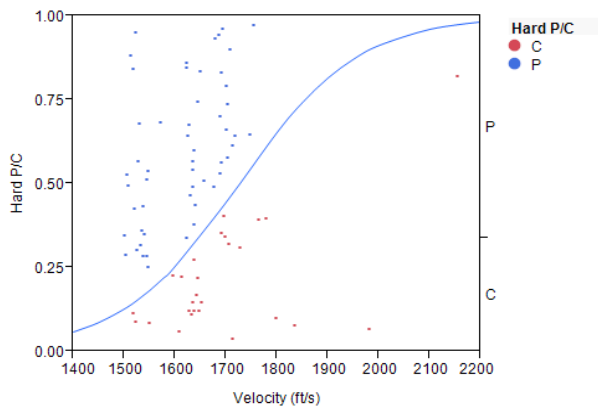
Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	5.222249	1	10.4445	0.0012
Full	45.926815			
Reduced	51.149064			

RSquare (U)	0.1021
AICc	96.0095
BIC	100.618
Observations (or Sum Wgts)	80

Measure	Training	Definition
Entropy RSquare	0.1021	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.1696	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.5741	$\sum$ -Log(ρ[j])/n
RMSE	0.4433	$\sqrt{\sum(y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3919	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.275	$\sum$ (ρ[j]$\neq\rho$Max)/n
N	80	n

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-14.73146	5.1610216	8.15	0.0043
Velocity (ft/s)	0.0085372	0.0031253	7.46	0.0063

For log odds of C/P

Inverse Prediction

Specified Probability(Hard P/C=C)	Predicted Velocity (ft/s)	Lower 90%
0.5	1725.559	1683.925
0.4	1678.065	1639.495
0.3	1626.312	1573.987
0.2	1563.177	1470.128
0.1	1468.189	1297.231
0.05	1380.664	1133.674
0.01	1187.313	769.003
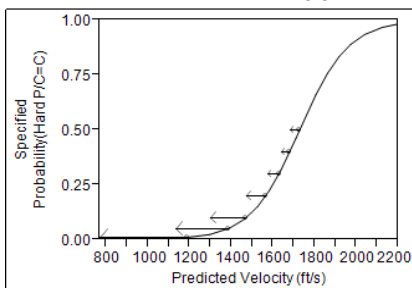
Appendix B. Impact Frequencies

3000 Series, 10% Light ESAPI

Threat D

Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
2500	0	0	0	0	2500	0	0	0	0
2550	20	0	19	1	2550	14	6	7	7
2600	1	0	1	0	2600	0	1	0	0
2650	0	0	0	0	2650	0	0	0	0
2700	0	0	0	0	2700	1	0	1	0
2750	22	0	16	6	2750	14	4	11	3
2800	17	0	13	4	2800	12	5	6	6
2850	25	2	20	5	2850	19	12	10	9
2900	10	3	7	3	2900	13	3	8	5
2950	2	0	2	0	2950	6	5	4	2
3000	5	0	3	2	3000	2	4	2	0
3050	4	1	1	3	3050	0	1	0	0
3100	1	3	0	1	3100	0	0	0	0
3150	2	3	0	2	3150	0	0	0	0
3200	0	1	0	0	3200	0	0	0	0
Totals	109	13	82	27	Totals	81	41	49	32

10% Light ESAPI, 1st Shot Threat D

Legend:
- System C
- Hard C / Soft P
- Hard P

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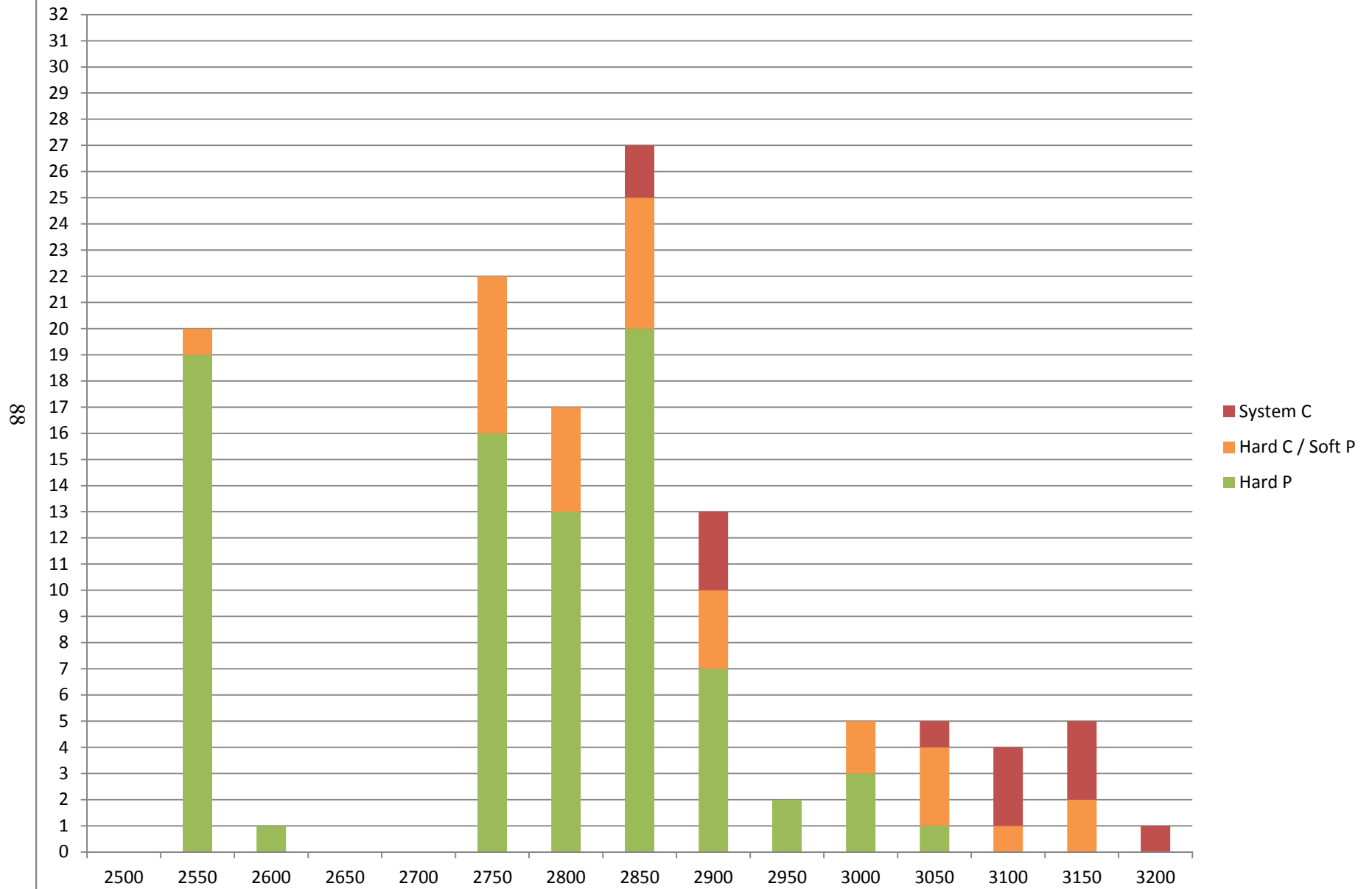
10% Light ESAPI, 2nd Shot Threat D

3000 Series, 10% Light ESAPI

Threat Y
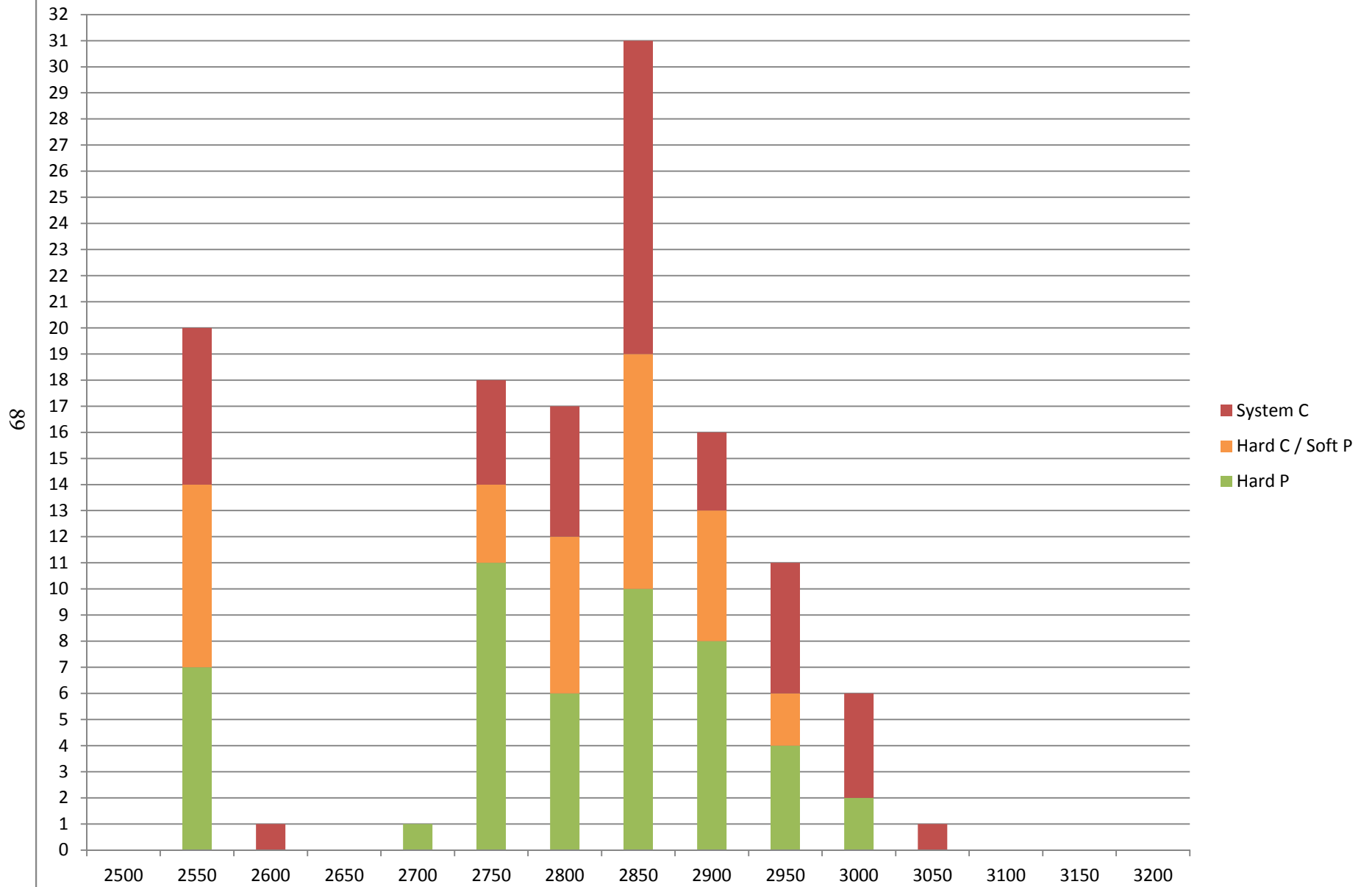
Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
3200	0	0	0	0	3200	0	0	0	0
3250	0	0	0	0	3250	0	0	0	0
3300	22	0	22	0	3300	21	1	20	1
3350	1	0	1	0	3350	0	0	0	0
3400	37	1	37	0	3400	36	0	35	1
3450	0	0	0	0	3450	3	0	3	0
3500	12	0	10	2	3500	9	1	9	0
3550	4	0	3	1	3550	2	0	2	0
3600	12	0	11	1	3600	13	0	11	2
3650	2	0	2	0	3650	1	0	1	0
3700	0	0	0	0	3700	1	0	0	1
3750	0	0	0	0	3750	0	0	0	0
3800	0	0	0	0	3800	3	0	2	1
3850	1	0	1	0	3850	0	0	0	0
3900	2	0	2	0	3900	1	0	1	0
3950	0	0	0	0	3950	2	0	2	0
4000	0	0	0	0	4000	0	0	0	0
Totals	93	1	89	4	Totals	92	2	86	6

10% Light ESAPI, 1st Shot Threat Y
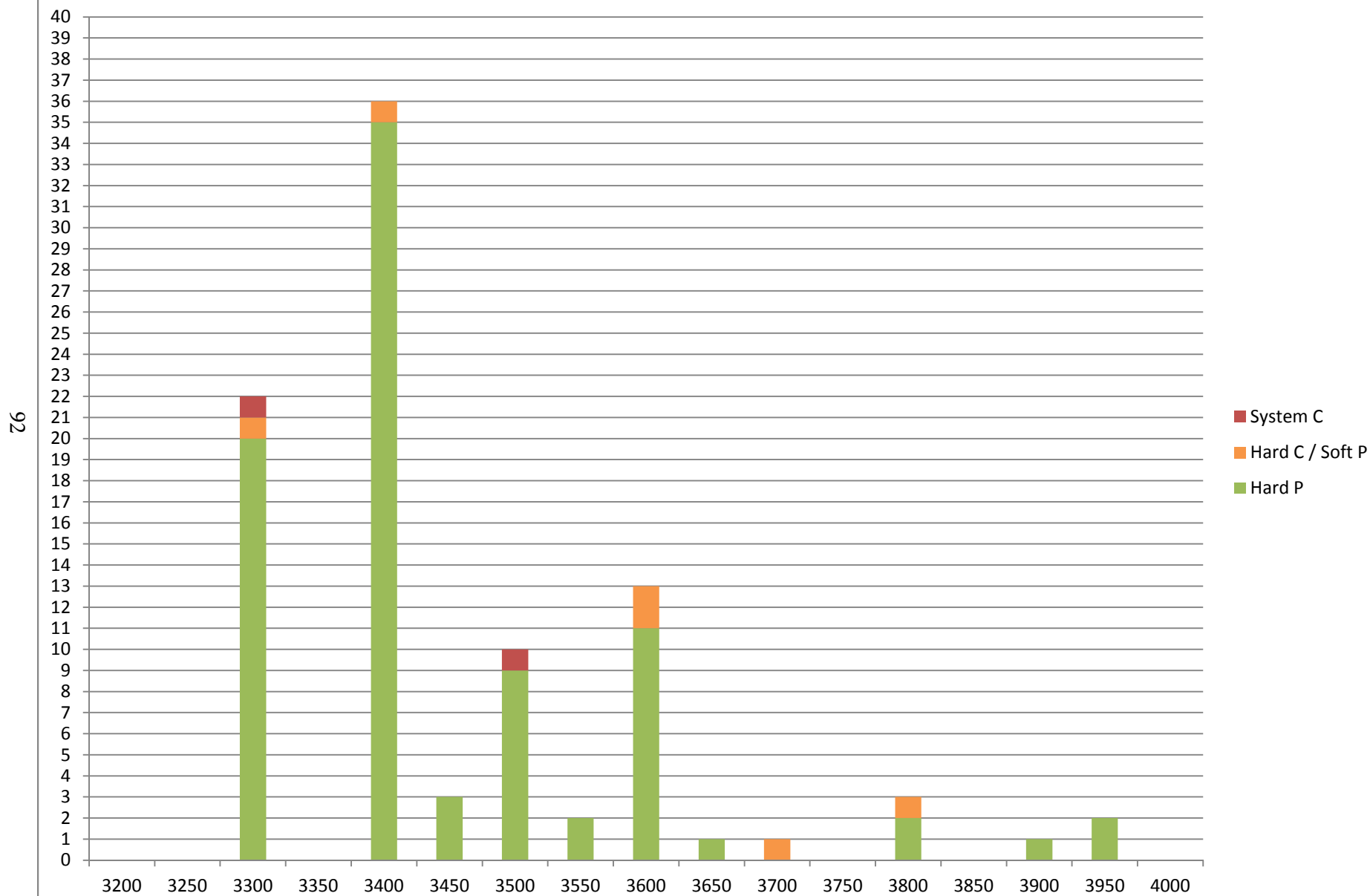
Legend:
- System C
- Hard C / Soft P
- Hard P

10% Light ESAPI, 2nd Shot Threat Y

3001 Series, 20% Light ESAPI

Threat D

Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
2200	0	0	0	0	2200	0	0	0	0
2250	0	0	0	0	2250	0	0	0	0
2300	0	0	0	0	2300	1	0	1	0
2350	3	0	2	1	2350	2	0	2	0
2400	23	0	11	12	2400	21	3	17	4
2450	2	1	2	0	2450	1	0	0	1
2500	11	1	8	3	2500	10	1	5	5
2550	4	0	3	1	2550	1	0	1	0
2600	6	0	3	3	2600	5	1	4	1
2650	5	0	2	3	2650	5	1	3	2
2700	2	0	1	1	2700	2	0	0	2
2750	3	1	2	1	2750	6	1	0	6
2800	1	2	0	1	2800	2	0	0	2
2850	3	2	0	3	2850	3	3	0	3
2900	0	2	0	0	2900	1	1	0	1
2950	0	0	0	0	2950	0	1	0	0
3000	0	0	0	0	3000	0	0	0	0
Totals	63	9	34	29	Totals	60	12	33	27

20% Light ESAPI, 1st Shot Threat D
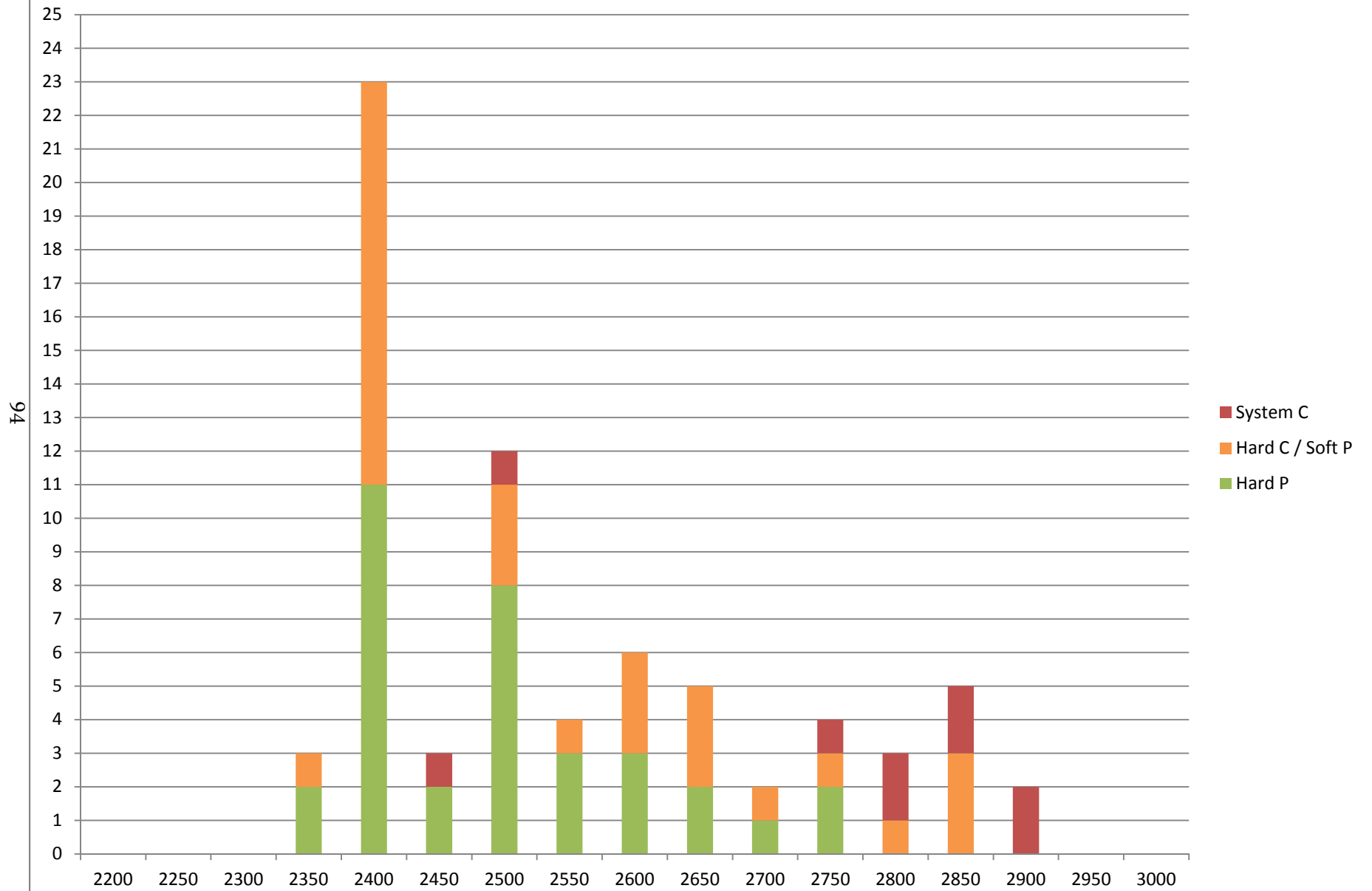
20% Light ESAPI, 2nd Shot Threat D

3001 Series, 20% Light ESAPI

Threat Y

Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
2500	0	0	0	0	2500	0	0	0	0
2550	13	0	13	0	2550	17	0	17	0
2600	29	1	27	2	2600	22	1	20	2
2650	23	1	19	4	2650	26	1	24	2
2700	4	0	2	2	2700	5	0	5	0
2750	4	1	2	2	2750	3	1	2	1
2800	3	2	3	0	2800	7	0	7	0
2850	6	2	6	0	2850	6	1	4	2
2900	3	0	2	1	2900	2	0	2	0
2950	3	1	1	2	2950	4	0	3	1
3000	5	1	4	1	3000	9	1	5	4
3050	4	4	3	1	3050	6	2	5	1
3100	3	1	1	2	3100	1	0	1	0
3150	1	1	0	1	3150	1	0	1	0
3200	0	0	0	0	3200	2	0	2	0
3250	2	0	1	1	3250	5	0	2	3
3300	2	1	1	1	3300	4	3	3	1
3350	2	2	2	0	3350	1	3	1	0
3400	2	1	1	1	3400	2	1	1	1
3450	4	1	3	1	3450	1	1	1	0
3500	3	2	1	2	3500	2	0	1	1
3550	1	1	1	0	3550	2	0	1	1
3600	0	1	0	0	3600	0	1	0	0
3650	1	0	0	1	3650	0	0	0	0
3700	1	0	0	1	3700	0	0	0	0
3750	0	0	0	0	3750	0	0	0	0
3800	0	0	0	0	3800	0	0	0	0
3850	0	1	0	0	3850	0	0	0	0
Totals	119	25	93	26	Totals	128	16	108	20
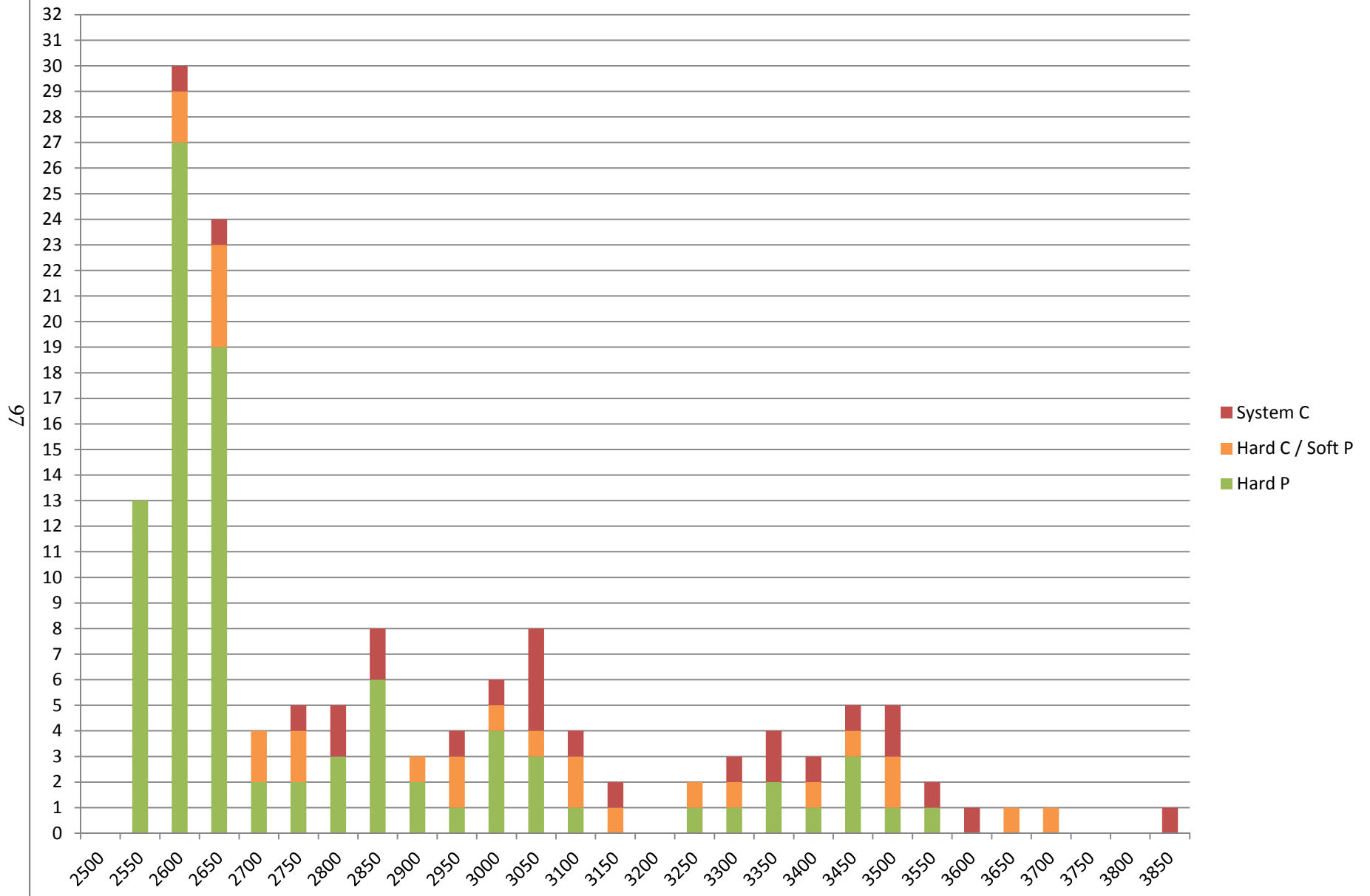
20% Light ESAPI, 2nd Shot Threat Y

3002 Series, 30% Light ESAPI

Threat D

	Shot 1					Shot 2			
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
1700	0	0	0	0	1700	0	0	0	0
1750	4	0	2	2	1750	4	0	4	0
1800	21	0	14	7	1800	16	2	11	5
1850	1	0	0	1	1850	2	1	0	2
1900	28	6	10	18	1900	31	2	23	8
1950	3	0	2	1	1950	1	0	1	0
2000	3	1	2	1	2000	0	0	0	0
2050	4	0	3	1	2050	1	1	1	0
2100	3	1	1	2	2100	4	0	3	1
2150	2	2	0	2	2150	10	4	2	8
2200	1	2	0	1	2200	2	4	2	0
2250	4	2	0	4	2250	1	5	0	1
2300	2	2	0	2	2300	0	2	0	0
2350	0	1	0	0	2350	0	0	0	0
2400	0	0	0	0	2400	0	0	0	0
2450	0	0	0	0	2450	0	0	0	0
2500	0	0	0	0	2500	0	1	0	0
2550	0	1	0	0	2550	0	0	0	0
2600	0	0	0	0	2600	0	0	0	0
2650	0	1	0	0	2650	0	1	0	0
2700	0	0	0	0	2700	0	0	0	0
2750	0	1	0	0	2750	0	2	0	0
2800	0	1	0	0	2800	0	0	0	0
2850	0	1	0	0	2850	1	0	0	1
2900	0	0	0	0	2900	0	0	0	0
2950	0	0	0	0	2950	0	0	0	0
3000	0	0	0	0	3000	0	1	0	0
3050	0	1	0	0	3050	0	0	0	0
Totals	76	23	34	42	Totals	73	26	47	26

30% Light ESAPI, 1st Shot Threat D
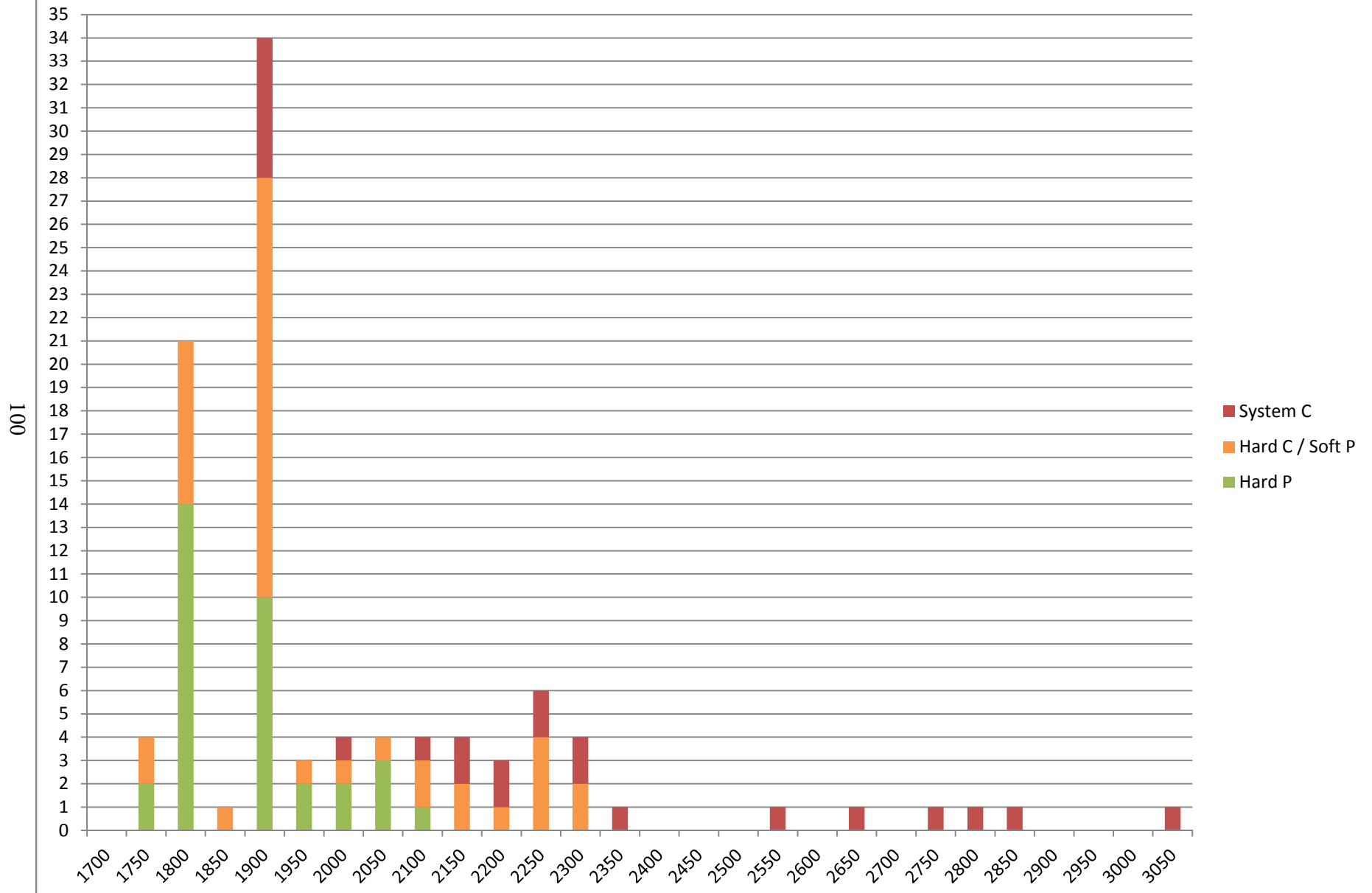
30% Light ESAPI, 2nd Shot Threat D
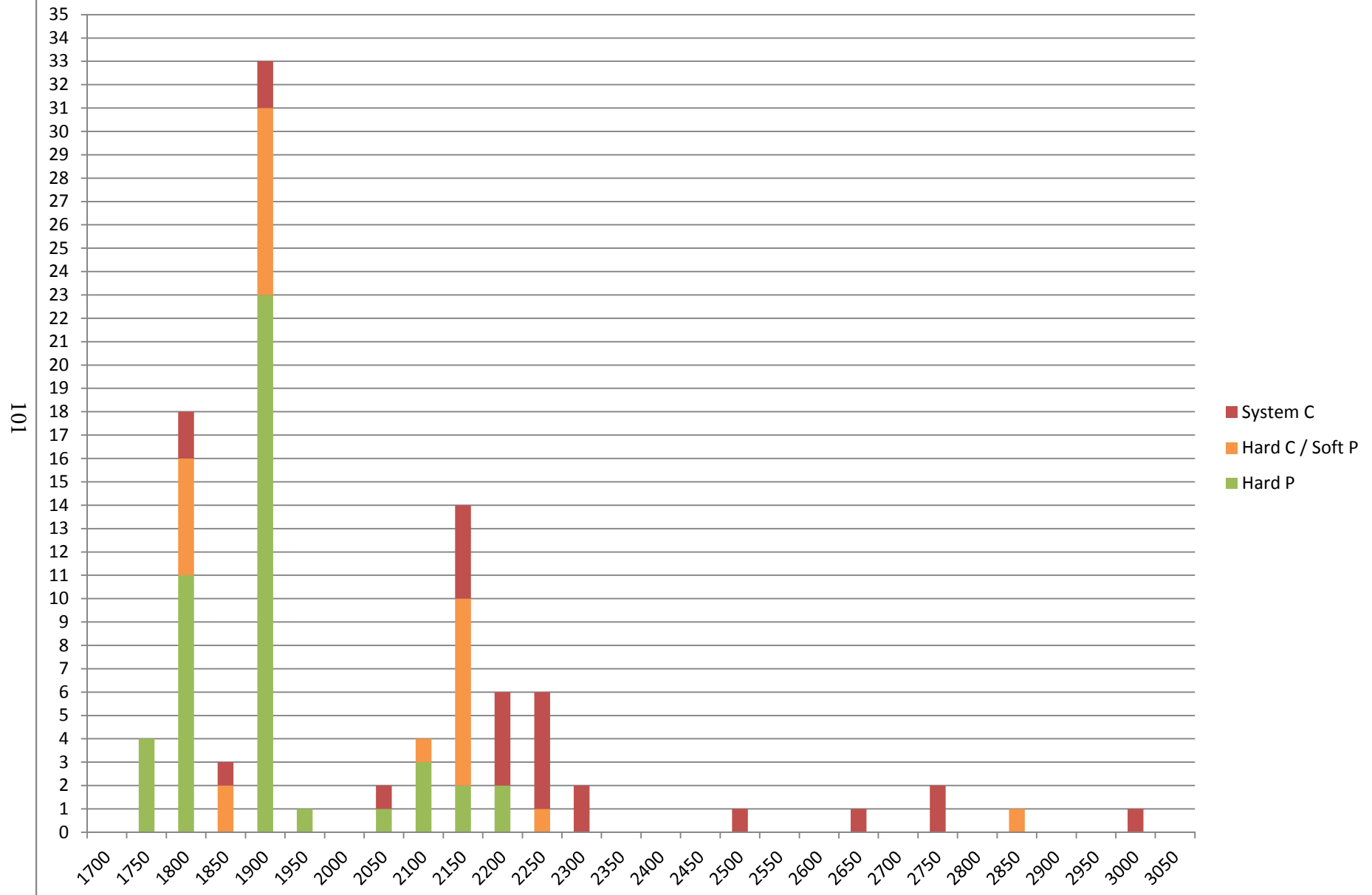
3002 Series, 30% Light ESAPI

Threat Y

		Shot 1					Shot 2		
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
2050	0	0	0	0	2050	0	0	0	0
2100	1	0	1	0	2100	0	0	0	0
2150	1	0	1	0	2150	0	0	0	0
2200	0	0	0	0	2200	0	0	0	0
2250	11	0	11	0	2250	11	0	11	0
2300	14	0	14	0	2300	13	0	13	0
2350	10	0	8	2	2350	13	0	11	2
2400	23	2	21	2	2400	17	1	16	1
2450	2	0	2	0	2450	0	0	0	0
2500	9	2	6	3	2500	0	0	0	0
2550	13	5	3	10	2550	9	4	1	8
2600	5	8	3	2	2600	12	2	5	7
2650	4	1	3	1	2650	3	3	3	0
2700	0	3	0	0	2700	2	3	2	0
2750	0	3	0	0	2750	2	1	1	1
2800	1	0	0	1	2800	1	0	1	0
2850	0	0	0	0	2850	6	2	5	1
2900	0	0	0	0	2900	4	2	1	3
2950	0	0	0	0	2950	2	2	1	1
3000	0	0	0	0	3000	1	0	0	1
3050	0	0	0	0	3050	0	1	0	0
3100	0	0	0	0	3100	0	0	0	0
3150	0	0	0	0	3150	0	1	0	0
3200	0	0	0	0	3200	0	0	0	0
3250	0	0	0	0	3250	0	0	0	0
3300	0	0	0	0	3300	0	0	0	0
3350	0	0	0	0	3350	0	0	0	0
3400	0	1	0	0	3400	0	1	0	0
Totals	94	25	73	21	Totals	96	23	71	25
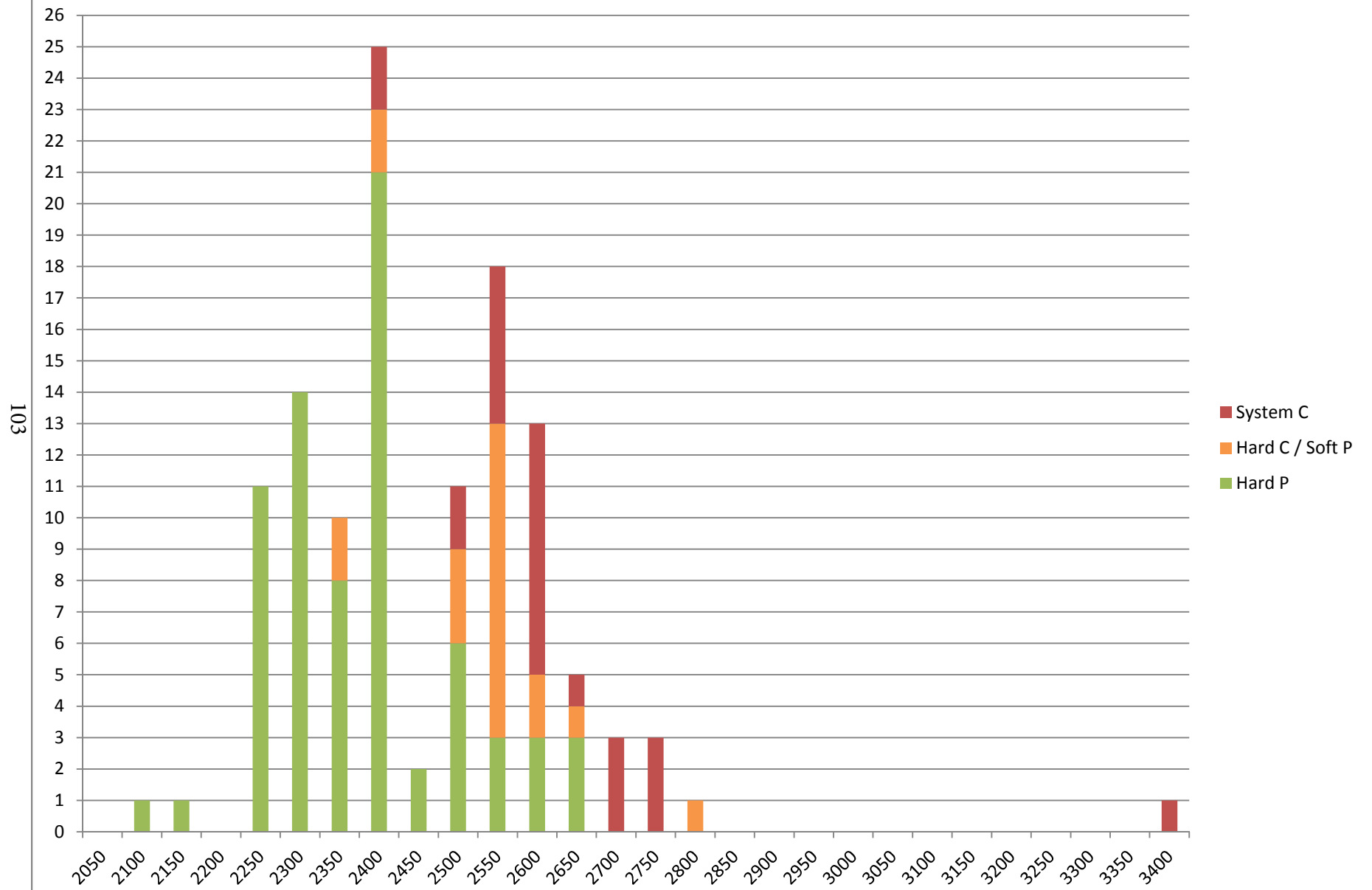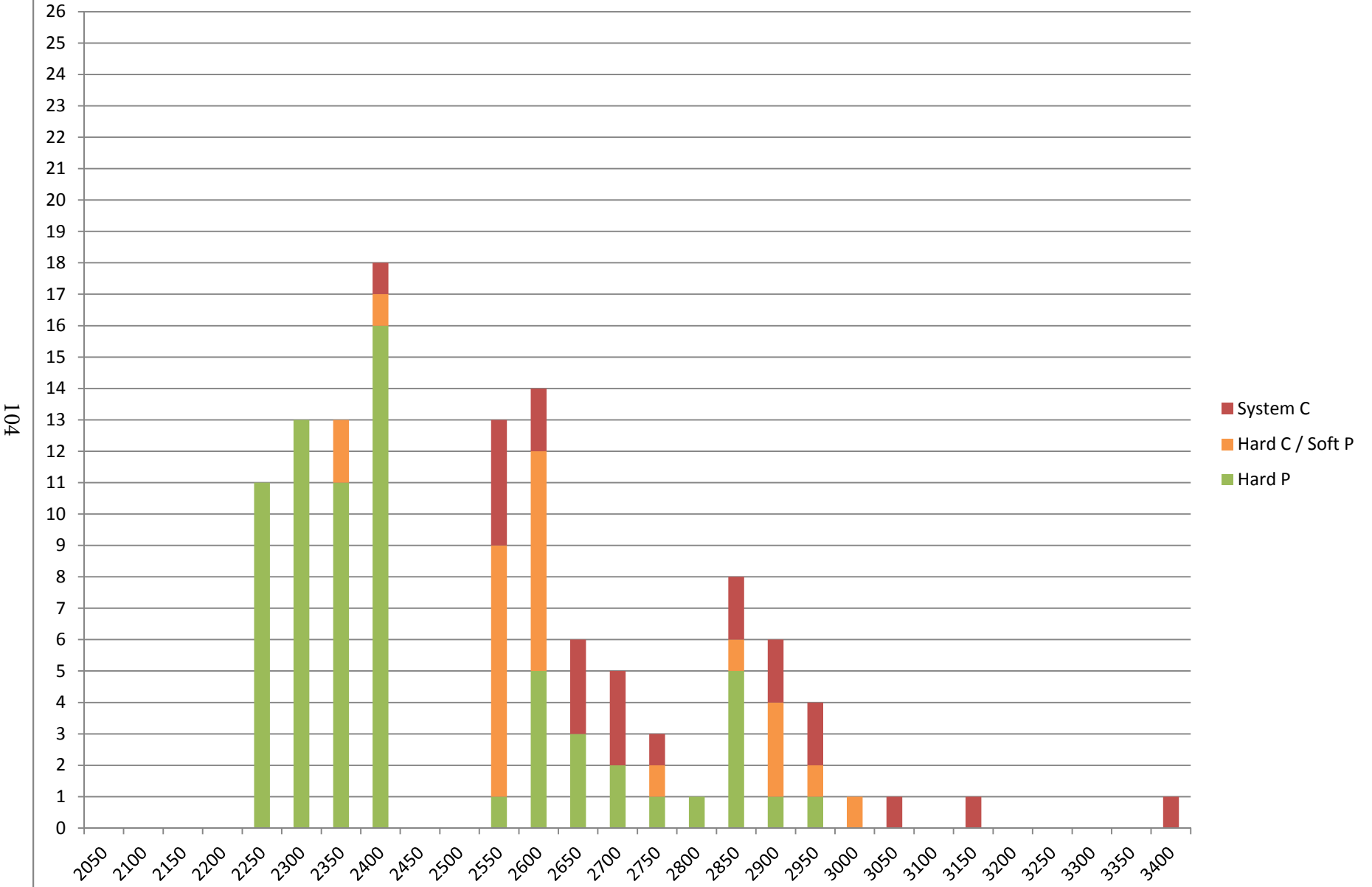
102

30% Light ESAPI, 1st Shot Threat Y

Legend:
- System C
- Hard C / Soft P
- Hard P

103

30% Light ESAPI, 2nd Shot Threat Y

104

3003 Series, 40% Light ESAPI

Threat D

Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
800	0	0	0	0	800	0	0	0	0
850	1	0	1	0	850	0	0	0	0
900	1	0	1	0	900	0	0	0	0
950	0	0	0	0	950	0	0	0	0
1000	1	0	1	0	1000	0	0	0	0
1050	2	0	1	1	1050	0	0	0	0
1100	15	0	12	3	1100	11	0	11	0
1150	16	0	8	8	1150	15	0	15	0
1200	12	0	3	9	1200	11	0	10	1
1250	17	0	5	12	1250	11	0	10	1
1300	9	1	1	8	1300	8	1	6	2
1350	16	3	4	12	1350	16	1	8	8
1400	2	3	0	2	1400	1	0	1	0
1450	1	1	0	1	1450	4	1	2	2
1500	0	0	0	0	1500	2	1	2	0
1550	0	3	0	0	1550	1	0	1	0
1600	1	1	0	1	1600	5	1	0	5
1650	0	0	0	0	1650	0	0	0	0
1700	0	0	0	0	1700	1	2	0	1
1750	0	0	0	0	1750	0	0	0	0
1800	0	0	0	0	1800	4	0	0	4
1850	0	0	0	0	1850	1	3	0	1
1900	0	0	0	0	1900	0	1	0	0
1950	0	0	0	0	1950	0	0	0	0
2000	0	0	0	0	2000	0	0	0	0
2050	0	0	0	0	2050	0	1	0	0
2100	0	0	0	0	2100	0	0	0	0
2150	0	0	0	0	2150	0	0	0	0
2200	0	0	0	0	2200	0	1	0	0
2250	0	0	0	0	2250	0	0	0	0
2300	0	0	0	0	2300	0	0	0	0
2350	0	0	0	0	2350	0	1	0	0
2400	0	0	0	0	2400	0	0	0	0
2450	0	0	0	0	2450	0	0	0	0
2500	0	0	0	0	2500	0	0	0	0
2550	0	0	0	0	2550	0	1	0	0
2600	0	0	0	0	2600	0	0	0	0
Totals	94	12	37	57	Totals	91	15	66	25

40% Light ESAPI, 1st Shot Threat D
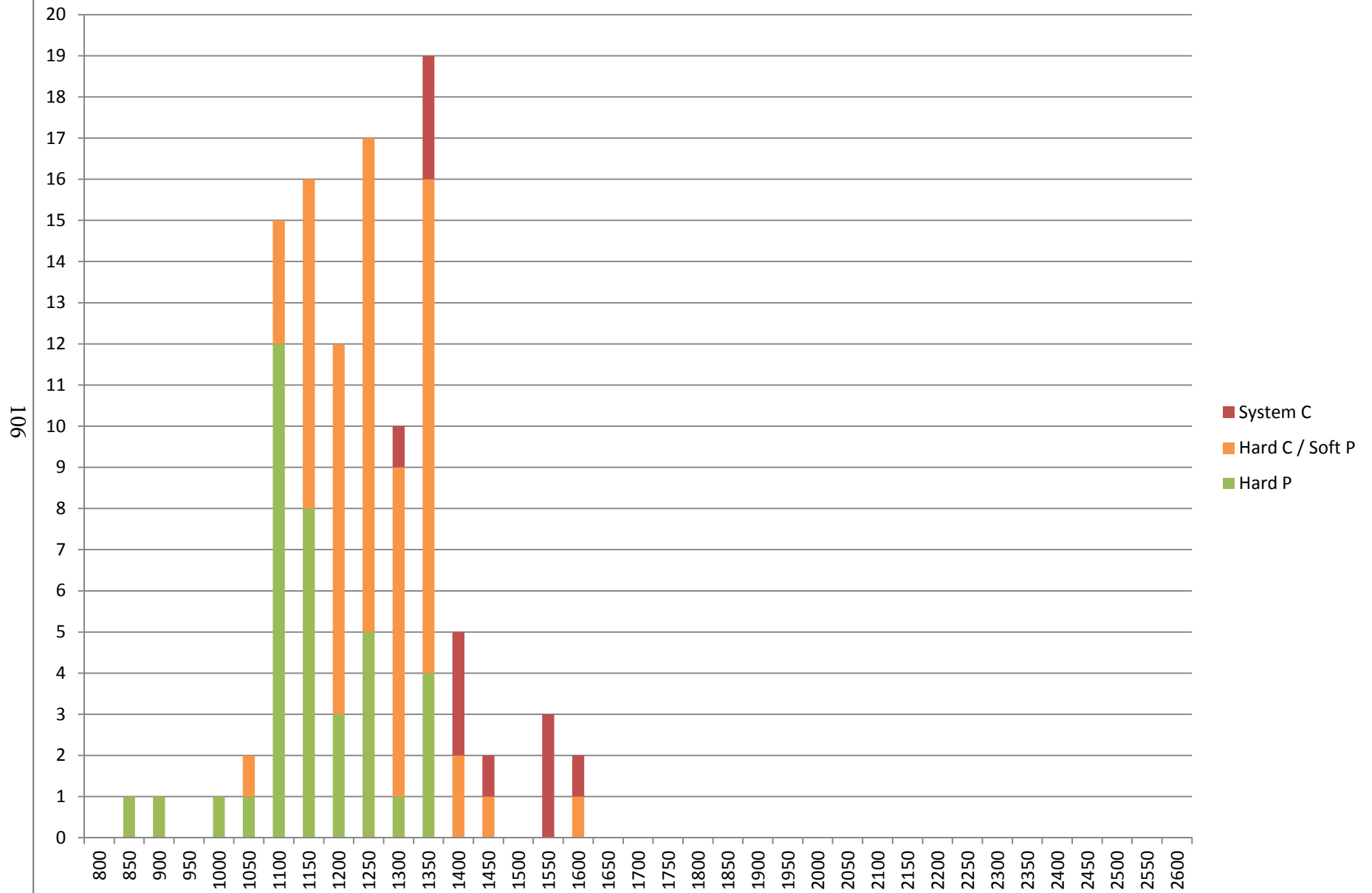
40% Light ESAPI, 2nd Shot Threat D
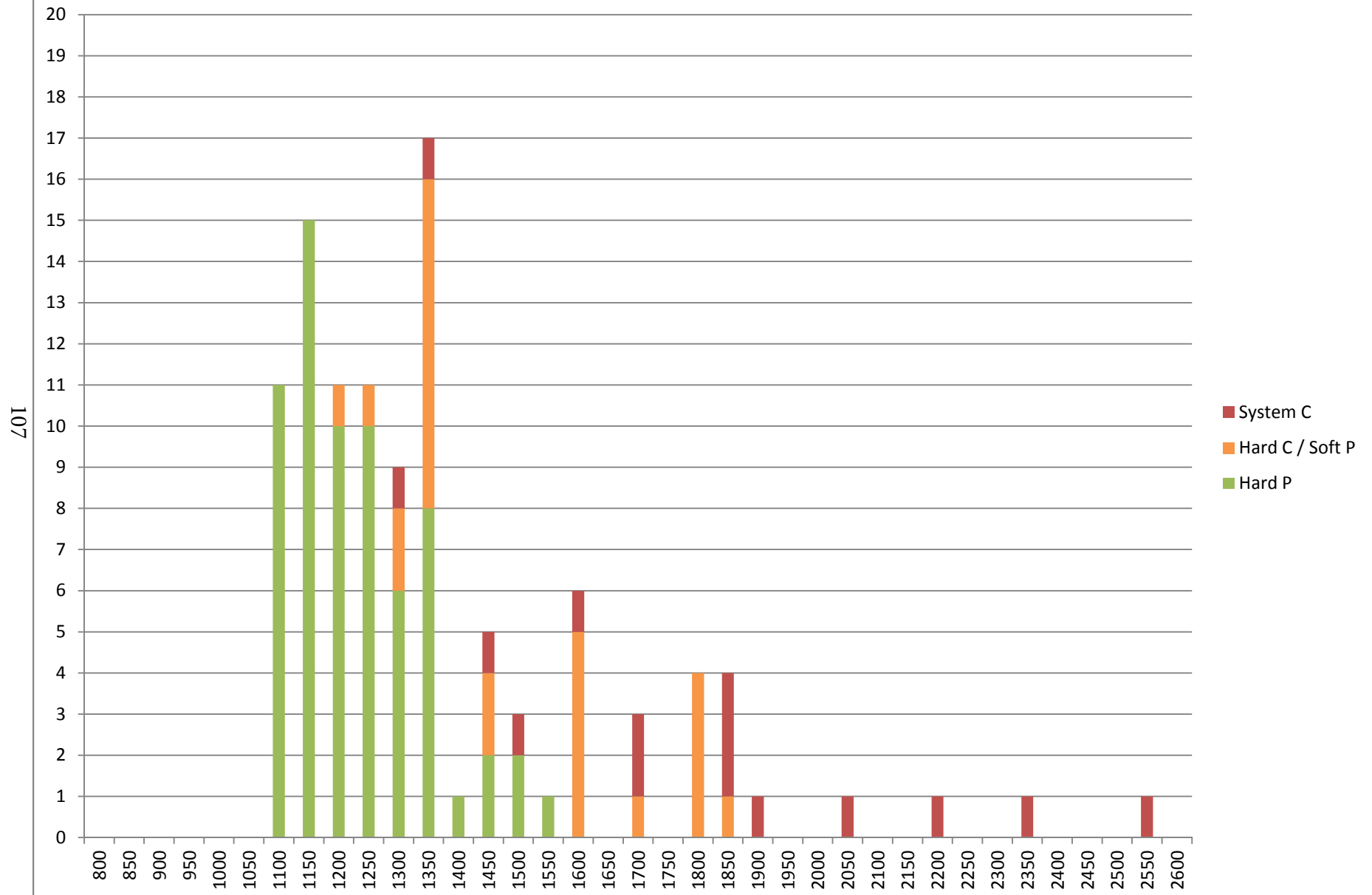
107

3003 Series, 40% Light ESAPI

Threat Y

Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
1900	0	0	0	0	1900	0	0	0	0
1950	0	0	0	0	1950	0	0	0	0
2000	11	0	9	2	2000	10	1	8	2
2050	16	0	13	3	2050	17	0	13	4
2100	16	0	12	4	2100	10	1	6	4
2150	41	1	23	18	2150	31	4	20	11
2200	2	1	1	1	2200	3	0	3	0
2250	3	1	1	2	2250	3	0	2	1
2300	1	0	0	1	2300	5	2	2	3
2350	0	1	0	0	2350	3	1	1	2
2400	1	0	0	1	2400	2	0	1	1
2450	2	1	1	1	2450	0	0	0	0
2500	2	0	0	2	2500	1	0	0	1
2550	2	2	1	1	2550	1	0	0	1
2600	0	3	0	0	2600	1	1	0	1
2650	0	2	0	0	2650	3	1	1	2
2700	0	0	0	0	2700	2	1	0	2
2750	0	1	0	0	2750	2	1	1	1
2800	0	0	0	0	2800	0	3	0	0
Totals	97	13	61	36	Totals	94	16	58	36

40% Light ESAPI, 1st Shot Threat Y
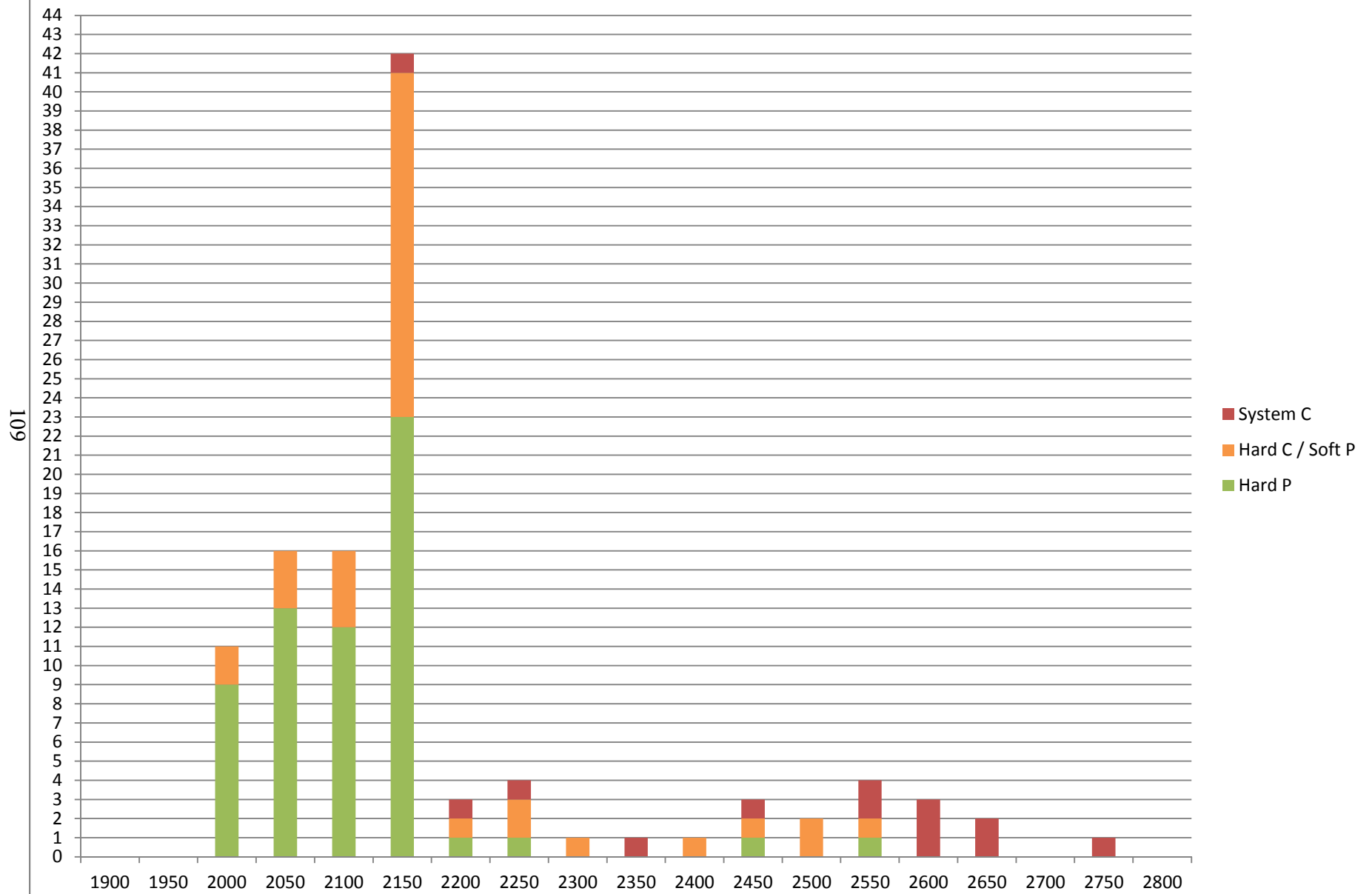
40% Light ESAPI, 2nd Shot Threat Y
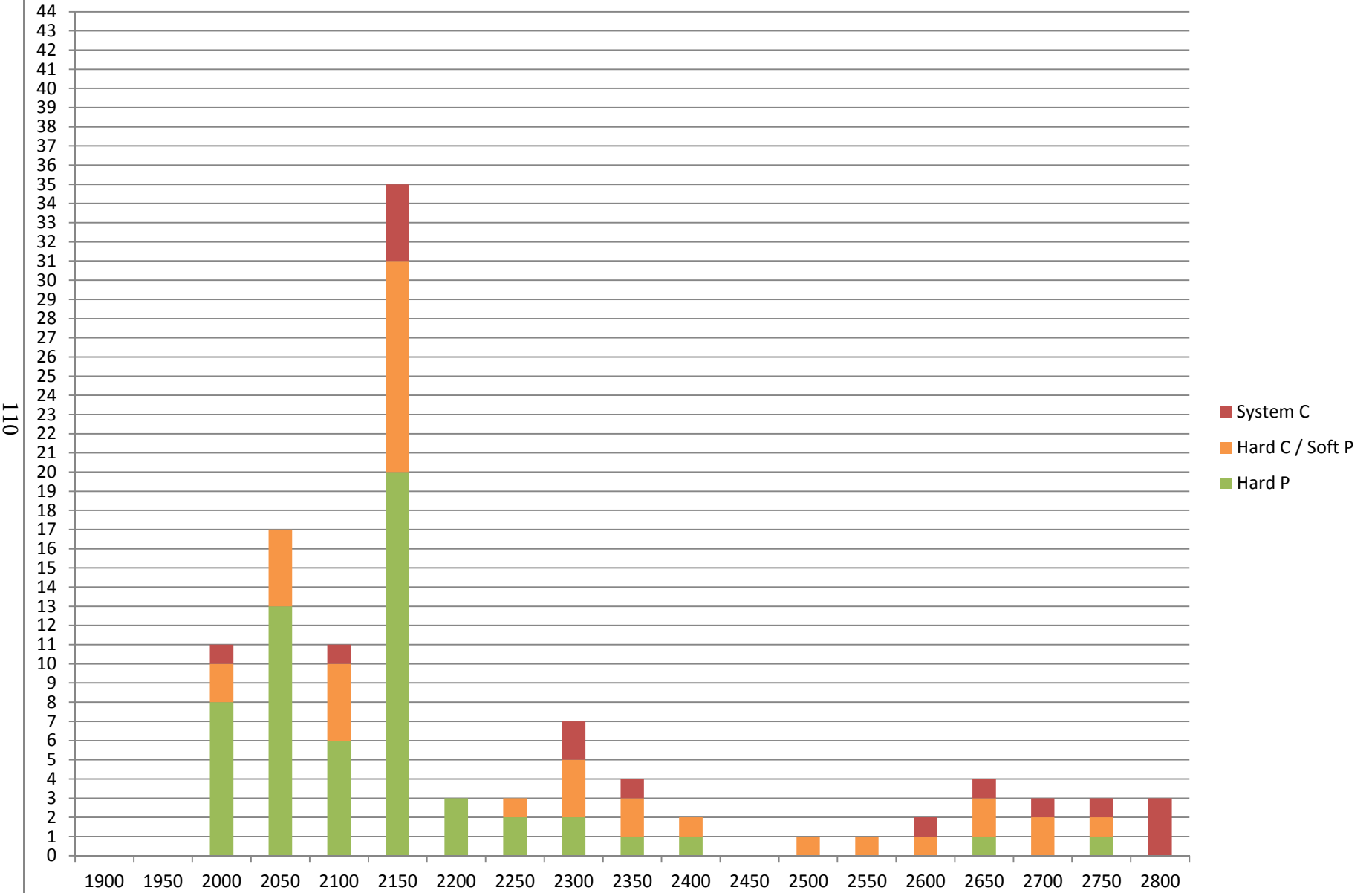
110

Legend:
- System C
- Hard C / Soft P
- Hard P

3004 Series, 10% Light XSAPI

Threat D

Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
2600	0	0	0	0	2600	0	0	0	0
2650	0	0	0	0	2650	1	0	0	1
2700	0	0	0	0	2700	1	0	0	1
2750	0	0	0	0	2750	2	0	0	2
2800	0	0	0	0	2800	3	2	2	1
2850	0	0	0	0	2850	7	3	4	3
2900	24	0	22	2	2900	18	11	11	7
2950	4	0	4	0	2950	10	4	5	5
3000	40	1	32	8	3000	25	11	12	13
3050	4	0	3	1	3050	0	0	0	0
3100	6	1	3	3	3100	0	0	0	0
3150	2	0	0	2	3150	0	1	0	0
3200	1	1	0	1	3200	0	0	0	0
3250	1	3	0	1	3250	0	0	0	0
3300	4	6	0	4	3300	0	1	0	0
3350	0	1	0	0	3350	0	0	0	0
3400	1	0	0	1	3400	0	0	0	0
Totals	87	13	64	23	Totals	67	33	34	33

10% Light XSAPI, 1st Shot Threat D
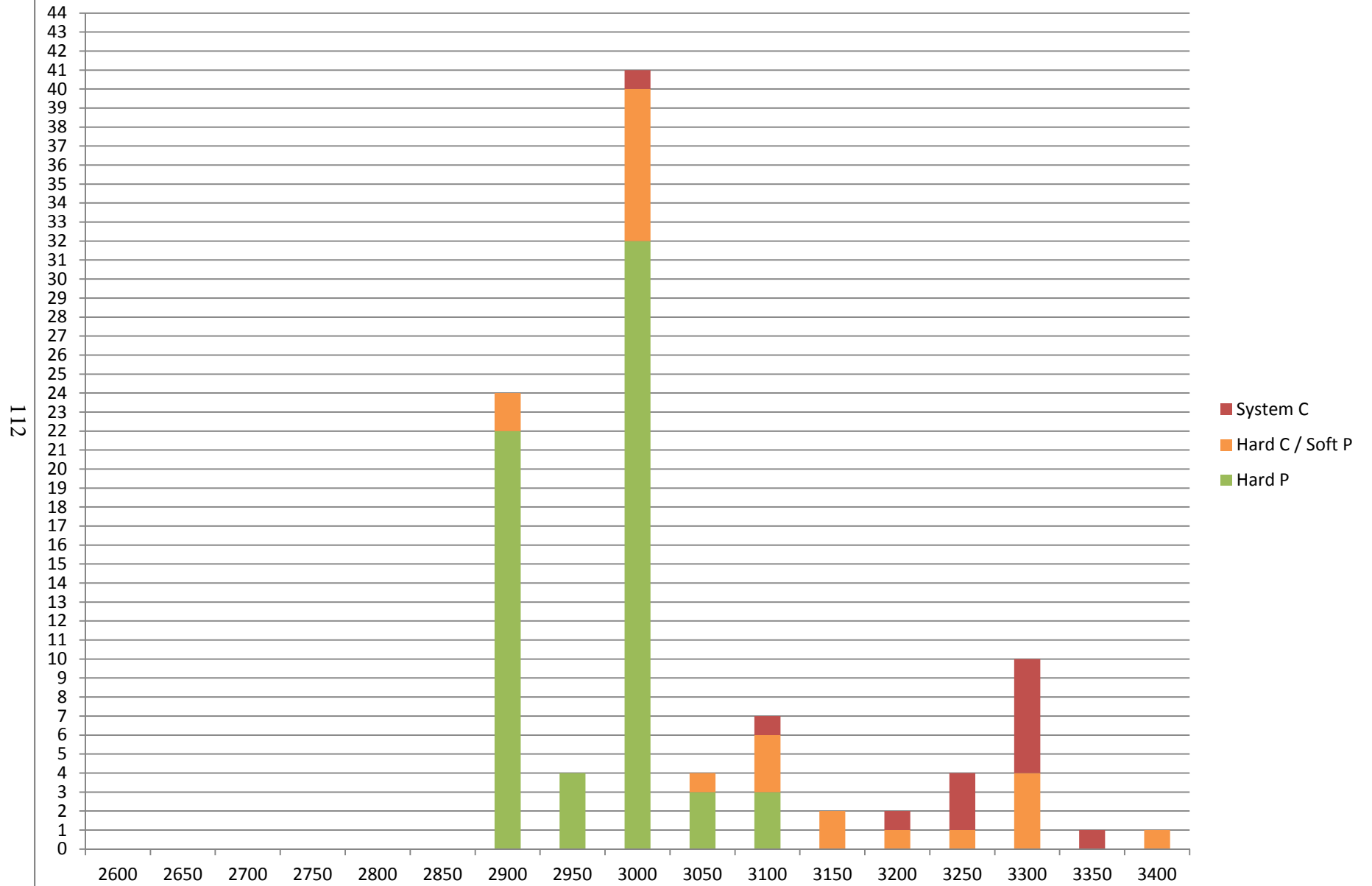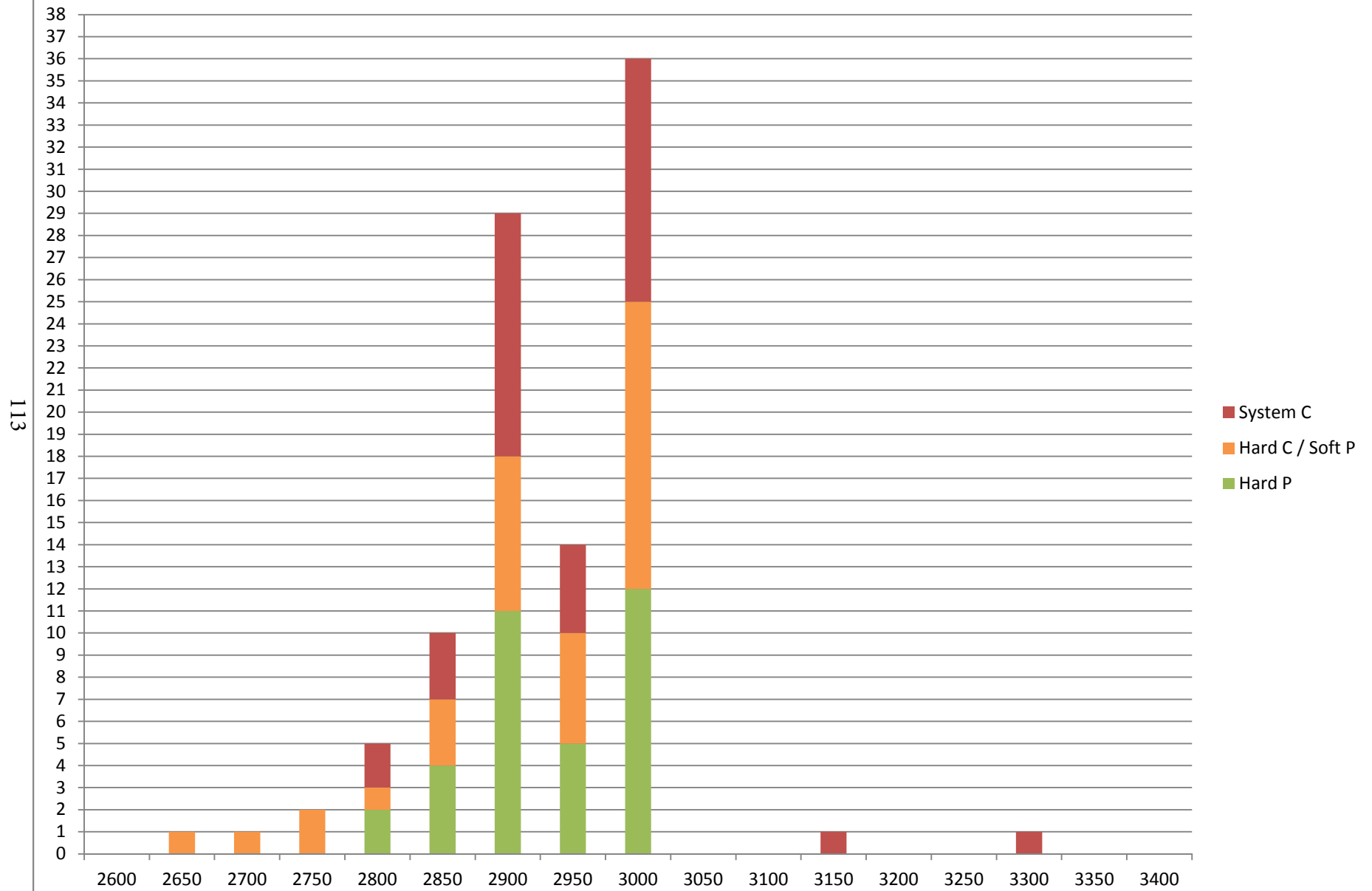
Legend:
- System C
- Hard C / Soft P
- Hard P

10% Light XSAPI, 2nd Shot Threat D

113

3004 Series, 10% Light XSAPI

Threat X

Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
2800	0	0	0	0	2800	0	0	0	0
2850	5	0	5	0	2850	7	0	7	0
2900	19	1	18	1	2900	21	0	20	1
2950	18	1	14	4	2950	15	0	15	0
3000	14	1	13	1	3000	14	1	11	3
3050	15	1	9	6	3050	13	1	10	3
3100	4	1	4	0	3100	3	0	3	0
3150	8	1	4	4	3150	1	0	1	0
3200	3	0	3	0	3200	1	1	1	0
3250	7	0	5	2	3250	4	1	3	1
3300	4	4	1	3	3300	8	2	4	4
3350	1	1	0	1	3350	1	0	0	1
3400	3	1	0	3	3400	3	1	2	1
3450	0	2	0	0	3450	4	0	4	0
3500	0	0	0	0	3500	2	2	2	0
3550	0	1	0	0	3550	2	3	0	2
3600	0	0	0	0	3600	3	1	1	2
3650	0	0	0	0	3650	0	1	0	0
Totals	101	15	76	25	Totals	102	14	84	18

10% Light XSAPI, 1st Shot Threat X
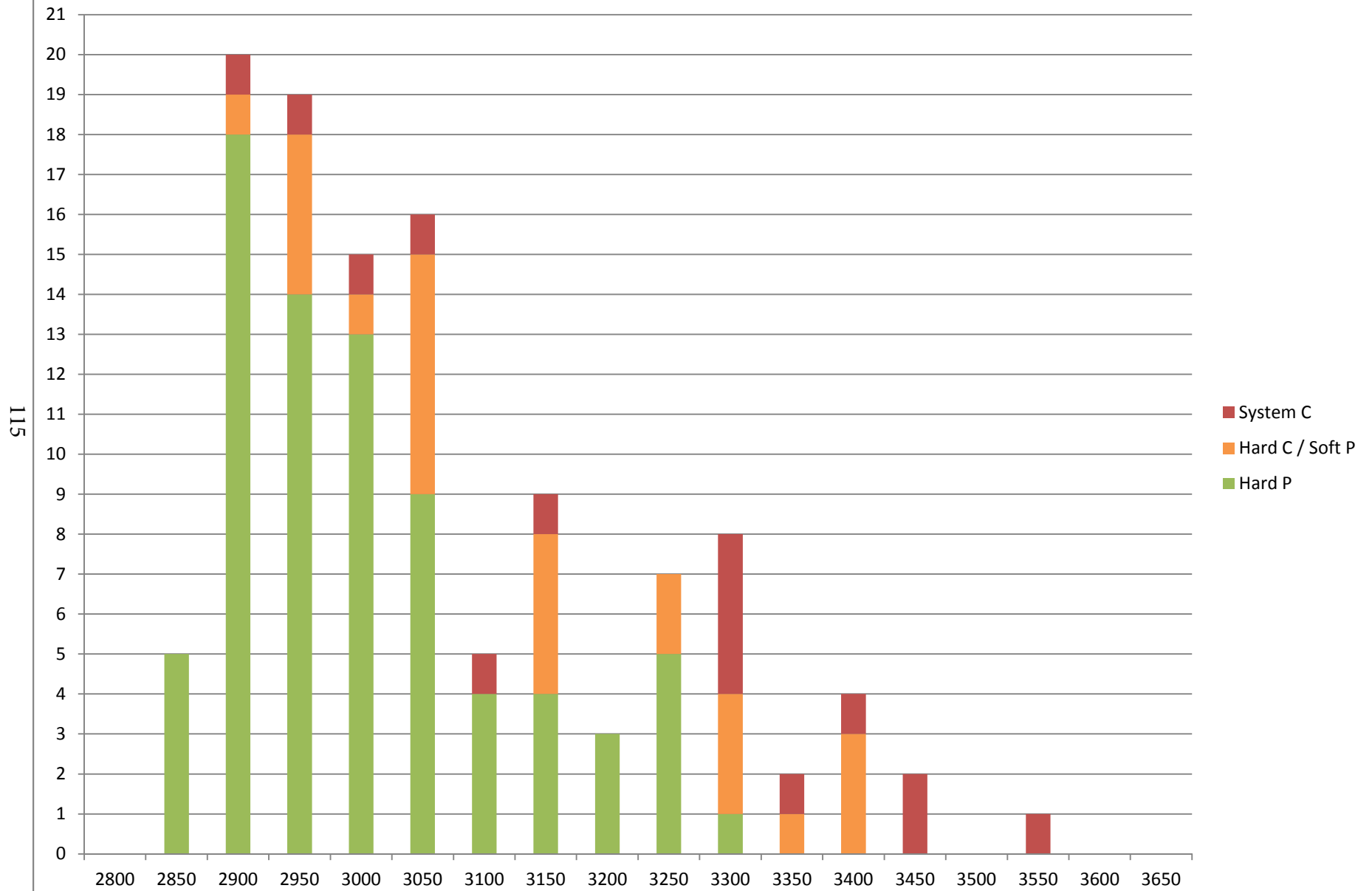
115
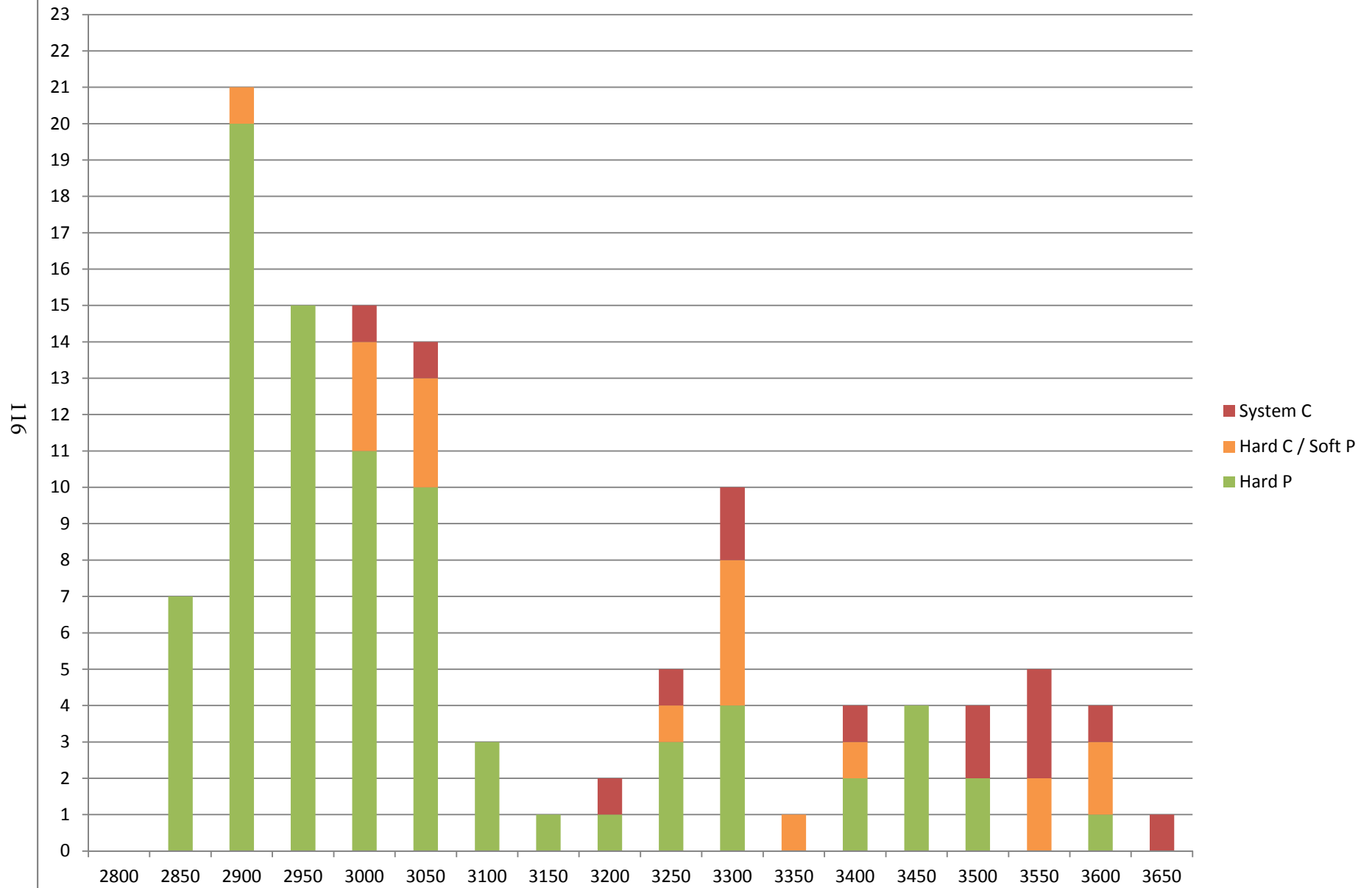
10% Light XSAPI, 2nd Shot Threat X

Legend:
- System C (dark red)
- Hard C / Soft P (orange)
- Hard P (green)

3005 Series, 20% Light XSAPI

Threat D

Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
2300	0	0	0	0	2300	0	0	0	0
2350	8	0	8	0	2350	11	0	9	2
2400	14	0	14	0	2400	12	0	10	2
2450	8	0	6	2	2450	10	0	5	5
2500	16	0	10	6	2500	13	0	8	5
2550	13	1	8	5	2550	9	1	5	4
2600	17	1	10	7	2600	17	5	11	6
2650	1	0	0	1	2650	4	2	2	2
2700	7	0	3	4	2700	5	1	1	4
2750	2	0	1	1	2750	3	0	1	2
2800	2	0	1	1	2800	1	3	0	1
2850	2	2	0	2	2850	2	3	0	2
2900	0	0	0	0	2900	3	3	1	2
2950	2	1	0	2	2950	1	1	0	1
3000	4	3	1	3	3000	0	0	0	0
3050	2	1	1	1	3050	0	0	0	0
3100	0	3	0	0	3100	0	0	0	0
Totals	98	12	63	35	Totals	91	19	53	38

117

20% Light XSAPI, 1st Shot Threat D

Legend:
- System C (dark red)
- Hard C / Soft P (orange)
- Hard P (green)

118

20% Light XSAPI, 2nd Shot Threat D

Legend:
- System C
- Hard C / Soft P
- Hard P

3005 Series, 20% Light XSAPI

Threat X

Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
2450	0	0	0	0	2450	0	0	0	0
2500	1	0	1	0	2500	0	0	0	0
2550	0	0	0	0	2550	0	0	0	0
2600	0	0	0	0	2600	1	0	1	0
2650	0	0	0	0	2650	0	0	0	0
2700	1	0	1	0	2700	0	0	0	0
2750	11	0	7	4	2750	13	0	9	4
2800	16	0	12	4	2800	10	0	6	4
2850	13	0	6	7	2850	13	0	6	7
2900	19	5	6	13	2900	16	4	8	8
2950	8	17	3	5	2950	10	10	5	5
3000	1	1	0	1	3000	5	3	1	4
3050	4	2	0	4	3050	5	4	2	3
3100	2	2	0	2	3100	2	8	1	1
3150	0	3	0	0	3150	0	2	0	0
Totals	76	30	36	40	Totals	75	31	39	36

120

20% Light XSAPI, 1st Shot Threat X

Legend:
- System C
- Hard C / Soft P
- Hard P

121

20% Light XSAPI, 2nd Shot Threat X

Legend:
- System C
- Hard C / Soft P
- Hard P

122

3006 Series, 30% Light XSAPI

Threat D

Shot 1					Shot 2			
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
1700	0	0	0	0	1700	0	0	0	0
1750	0	0	0	0	1750	1	0	1	0
1800	11	0	8	3	1800	10	0	9	1
1850	14	0	12	2	1850	12	0	9	3
1900	25	0	20	5	1900	25	0	24	1
1950	14	1	12	2	1950	16	0	16	0
2000	0	0	0	0	2000	1	0	1	0
2050	0	0	0	0	2050	0	0	0	0
2100	2	0	1	1	2100	0	0	0	0
2150	6	0	4	2	2150	0	0	0	0
2200	4	0	2	2	2200	0	0	0	0
2250	4	0	1	3	2250	7	0	6	1
2300	3	0	1	2	2300	6	0	3	3
2350	2	0	0	2	2350	5	0	1	4
2400	2	2	0	2	2400	2	0	0	2
2450	1	1	0	1	2450	0	1	0	0
2500	2	4	0	2	2500	1	0	0	1
2550	2	4	0	2	2550	2	1	0	2
2600	0	1	0	0	2600	4	3	0	4
2650	0	0	0	0	2650	1	5	0	1
2700	0	0	0	0	2700	0	2	0	0
Totals	92	13	61	31	Totals	93	12	70	23

30% Light XSAPI, 1st Shot Threat D
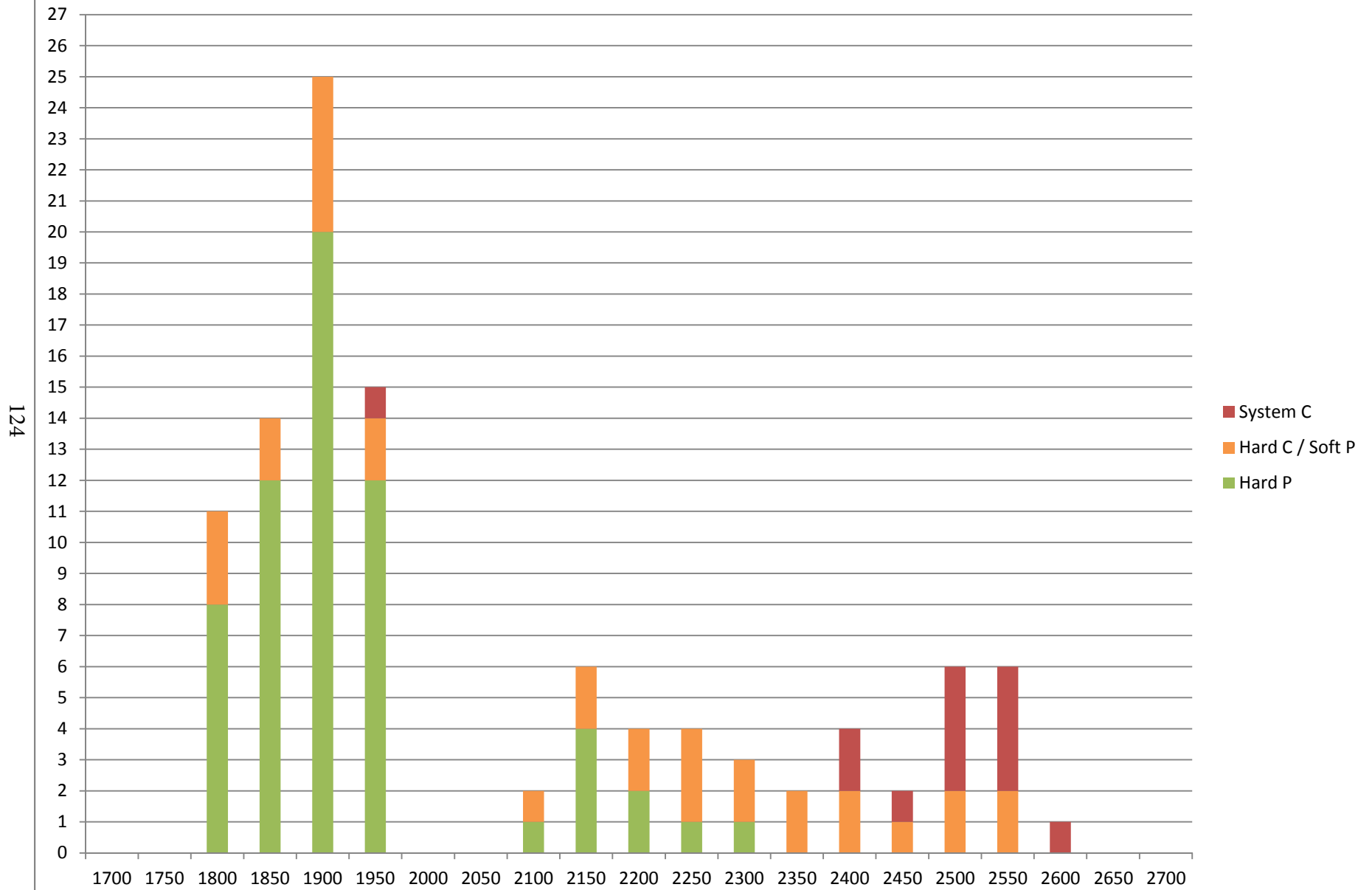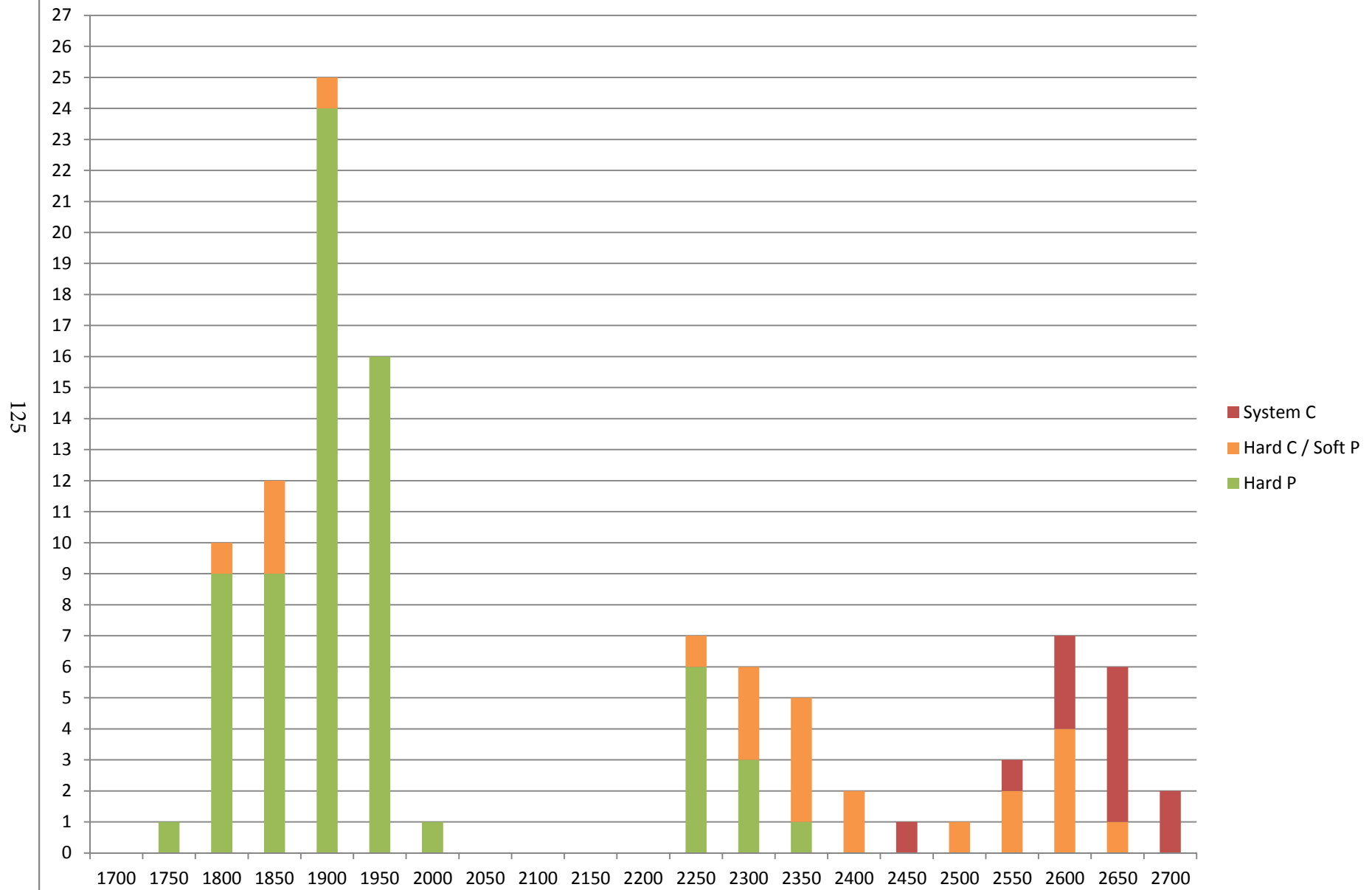
124

30% Light XSAPI, 2nd Shot Threat D

125

3006 Series, 30% Light XSAPI

Threat X

Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
2100	0	0	0	0	2100	0	0	0	0
2150	1	0	1	0	2150	1	0	1	0
2200	17	0	13	4	2200	12	0	6	6
2250	10	0	9	1	2250	12	0	8	4
2300	16	0	8	8	2300	15	0	10	5
2350	12	0	5	7	2350	10	0	6	4
2400	20	1	8	12	2400	18	0	9	9
2450	10	2	2	8	2450	15	0	6	9
2500	1	0	0	1	2500	3	1	2	1
2550	1	0	0	1	2550	2	0	0	2
2600	2	0	0	2	2600	1	0	0	1
2650	5	1	1	4	2650	1	0	0	1
2700	4	2	0	4	2700	0	0	0	0
2750	1	5	0	1	2750	0	0	0	0
2800	0	0	0	0	2800	0	0	0	0
2850	0	0	0	0	2850	1	0	0	1
2900	0	0	0	0	2900	0	0	0	0
2950	0	0	0	0	2950	2	1	1	1
3000	0	0	0	0	3000	2	1	0	2
3050	0	0	0	0	3050	2	3	0	2
3100	0	0	0	0	3100	1	6	0	1
3150	0	0	0	0	3150	0	1	0	0
Totals	100	11	47	53	Totals	98	13	49	49

30% Light XSAPI, 1st Shot Threat X
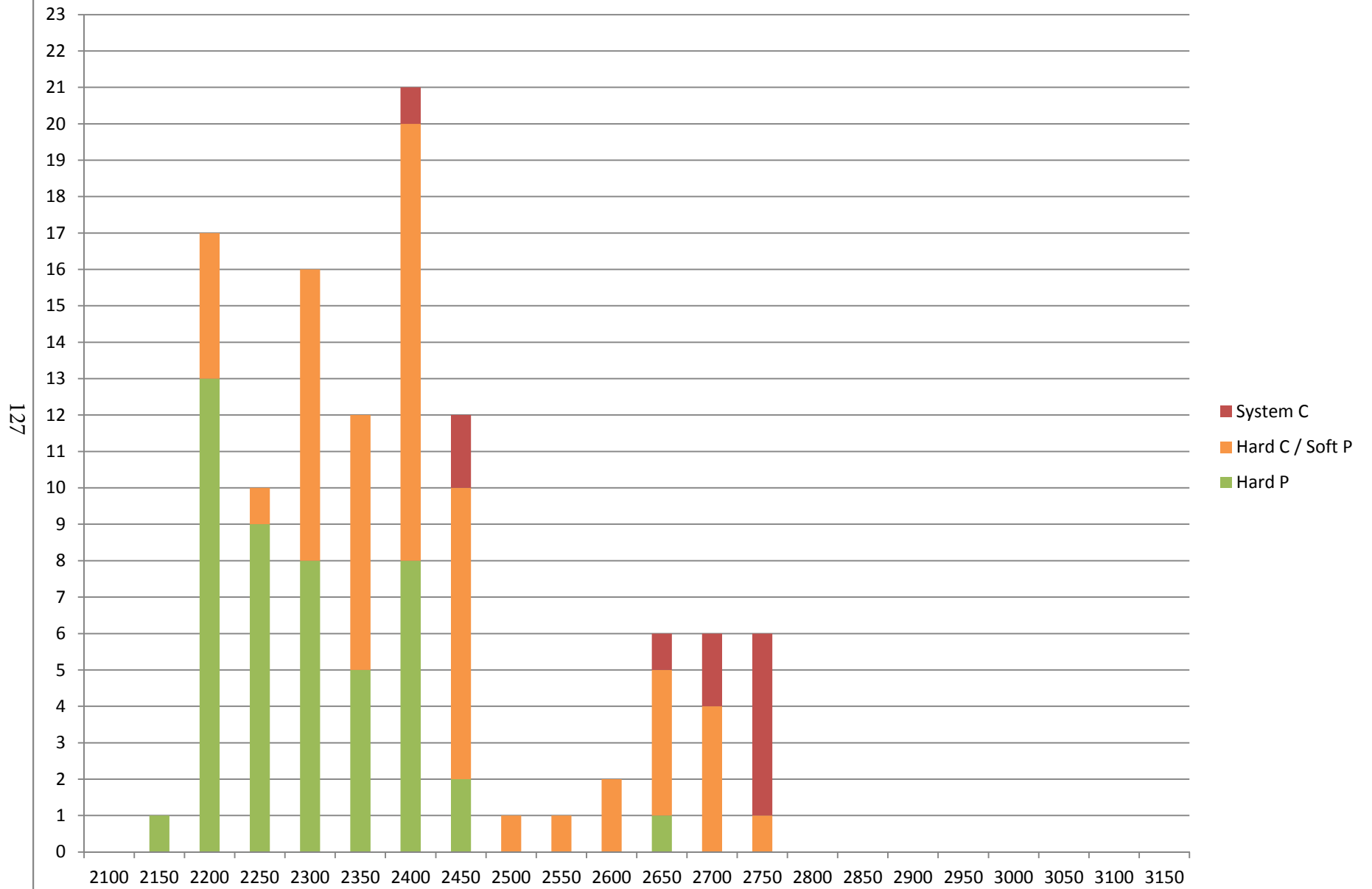
Legend:
- System C
- Hard C / Soft P
- Hard P

127

30% Light XSAPI, 2nd Shot Threat X

128

3007 Series, 40% Light XSAPI

Threat D
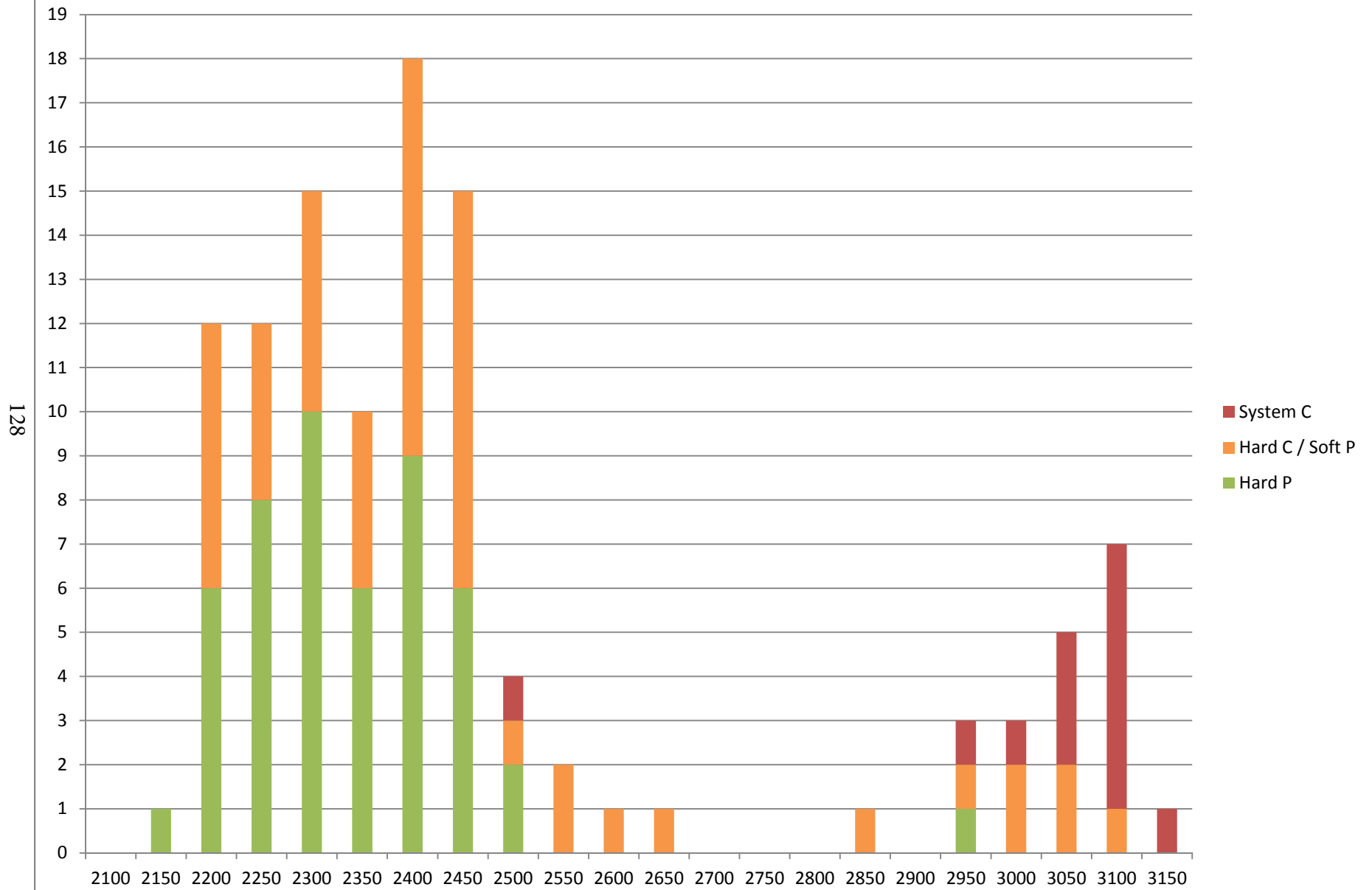
Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
450	0	0	0	0	450	0	0	0	0
500	1	0	1	0	500	0	0	0	0
550	0	0	0	0	550	0	0	0	0
600	0	0	0	0	600	0	0	0	0
650	0	0	0	0	650	0	0	0	0
700	0	0	0	0	700	0	0	0	0
750	0	0	0	0	750	0	0	0	0
800	0	0	0	0	800	0	0	0	0
850	0	0	0	0	850	0	0	0	0
900	0	0	0	0	900	0	0	0	0
950	11	0	11	0	950	9	0	9	0
1000	13	0	13	0	1000	14	0	13	1
1050	13	0	12	1	1050	5	0	5	0
1100	12	0	9	3	1100	17	0	17	0
1150	8	0	4	4	1150	6	0	5	1
1200	18	0	8	10	1200	16	0	16	0
1250	11	0	4	7	1250	14	0	11	3
1300	15	0	6	9	1300	14	0	8	6
1350	8	1	2	7	1350	7	0	4	3
1400	12	0	3	9	1400	16	0	8	8
1450	0	0	0	0	1450	5	0	2	3
1500	0	0	0	0	1500	2	0	0	2
1550	0	1	0	1	1550	1	0	1	0
1600	1	2	0	3	1600	1	3	0	4
1650	1	1	0	2	1650	0	0	0	0
1700	1	0	0	1	1700	1	2	0	3
1750	0	2	0	2	1750	0	1	0	1
1800	0	1	0	1	1800	0	0	0	0
1850	0	2	0	2	1850	0	0	0	0
1900	0	0	0	0	1900	0	1	0	1
1950	0	0	0	0	1950	0	0	0	0
2000	0	0	0	0	2000	0	0	0	0
2050	0	1	0	1	2050	0	0	0	0
2100	0	0	0	0	2100	0	1	0	1
Totals	125	11	73	63	Totals	128	8	99	37

40% Light XSAPI, 1st Shot Threat D
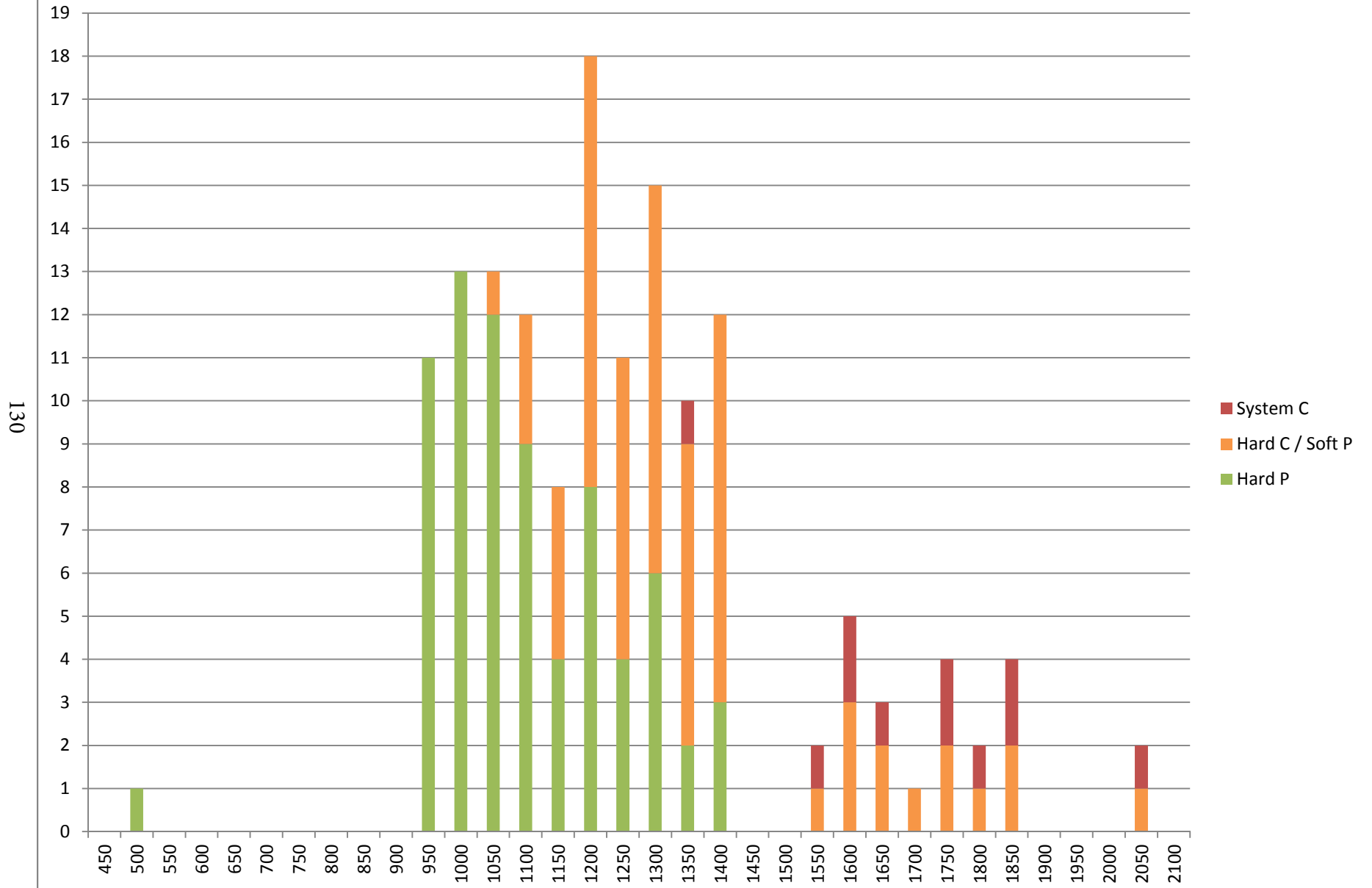
40% Light XSAPI, 2nd Shot Threat D
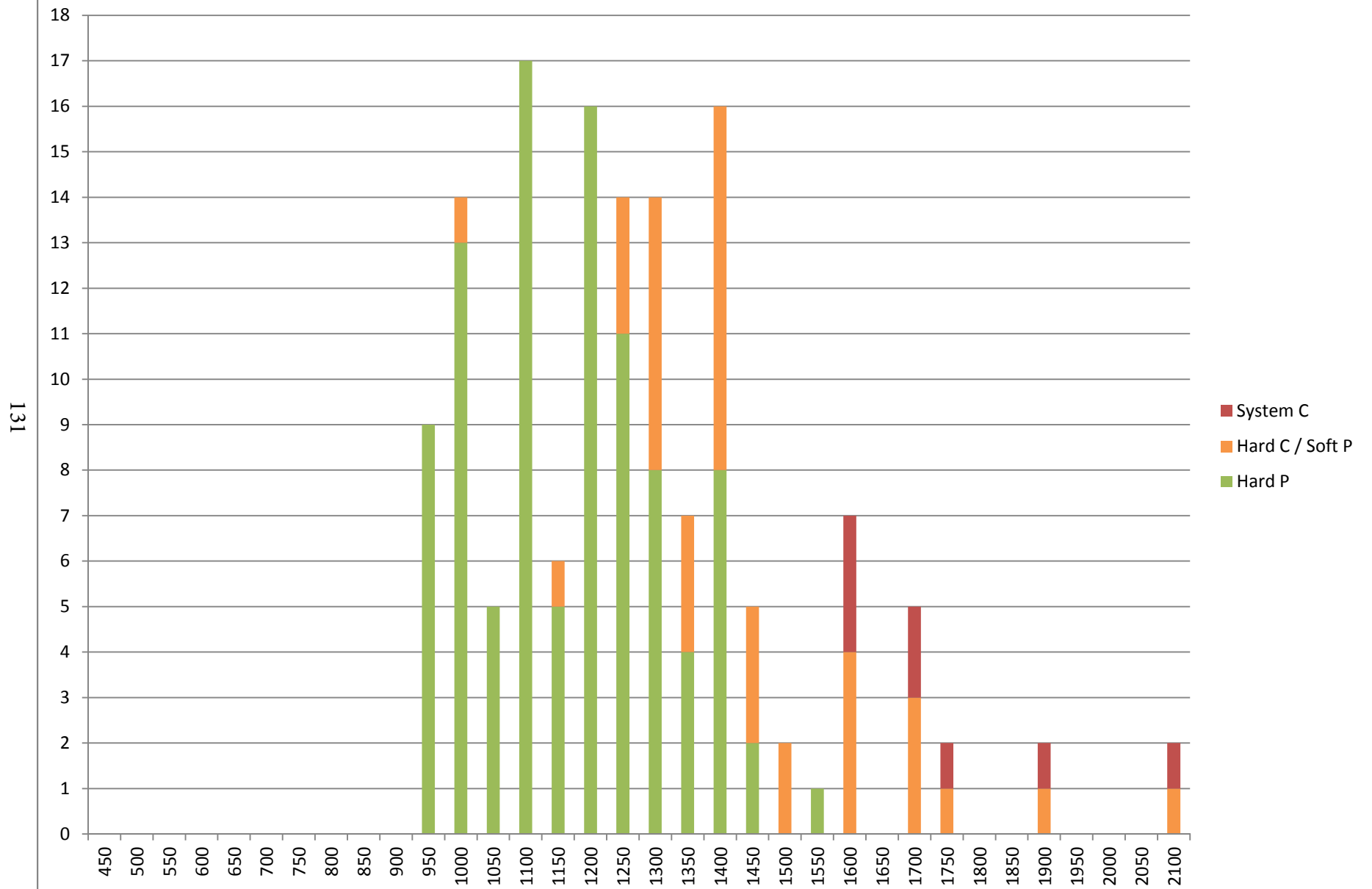
3007 Series, 40% Light XSAPI

Threat X

Shot 1					Shot 2				
Freq. Velocity	System P	System C	Hard P	Hard C / Soft P	Freq. Velocity	System P	System C	Hard P	Hard C / Soft P
1500	0	0	0	0	1500	0	0	0	0
1550	22	0	14	8	1550	23	0	20	3
1600	0	0	0	0	1600	2	0	1	1
1650	23	0	12	11	1650	22	2	14	8
1700	17	2	11	6	1700	13	0	9	4
1750	7	0	4	3	1750	11	0	8	3
1800	3	1	1	2	1800	4	0	1	3
1850	2	0	0	2	1850	1	0	0	1
1900	1	0	0	1	1900	0	0	0	0
1950	0	0	0	0	1950	0	0	0	0
2000	1	0	0	1	2000	1	0	0	1
2050	0	0	0	0	2050	0	0	0	0
2100	0	0	0	0	2100	0	0	0	0
2150	0	0	0	0	2150	0	0	0	0
2200	1	0	0	1	2200	1	0	0	1
Totals	77	3	42	35	Totals	78	2	53	25

40% Light XSAPI, 1st Shot Threat X

Legend:
- System C
- Hard C / Soft P
- Hard P

40% Light XSAPI, 2nd Shot Threat X

Legend:
- System C
- Hard C / Soft P
- Hard P

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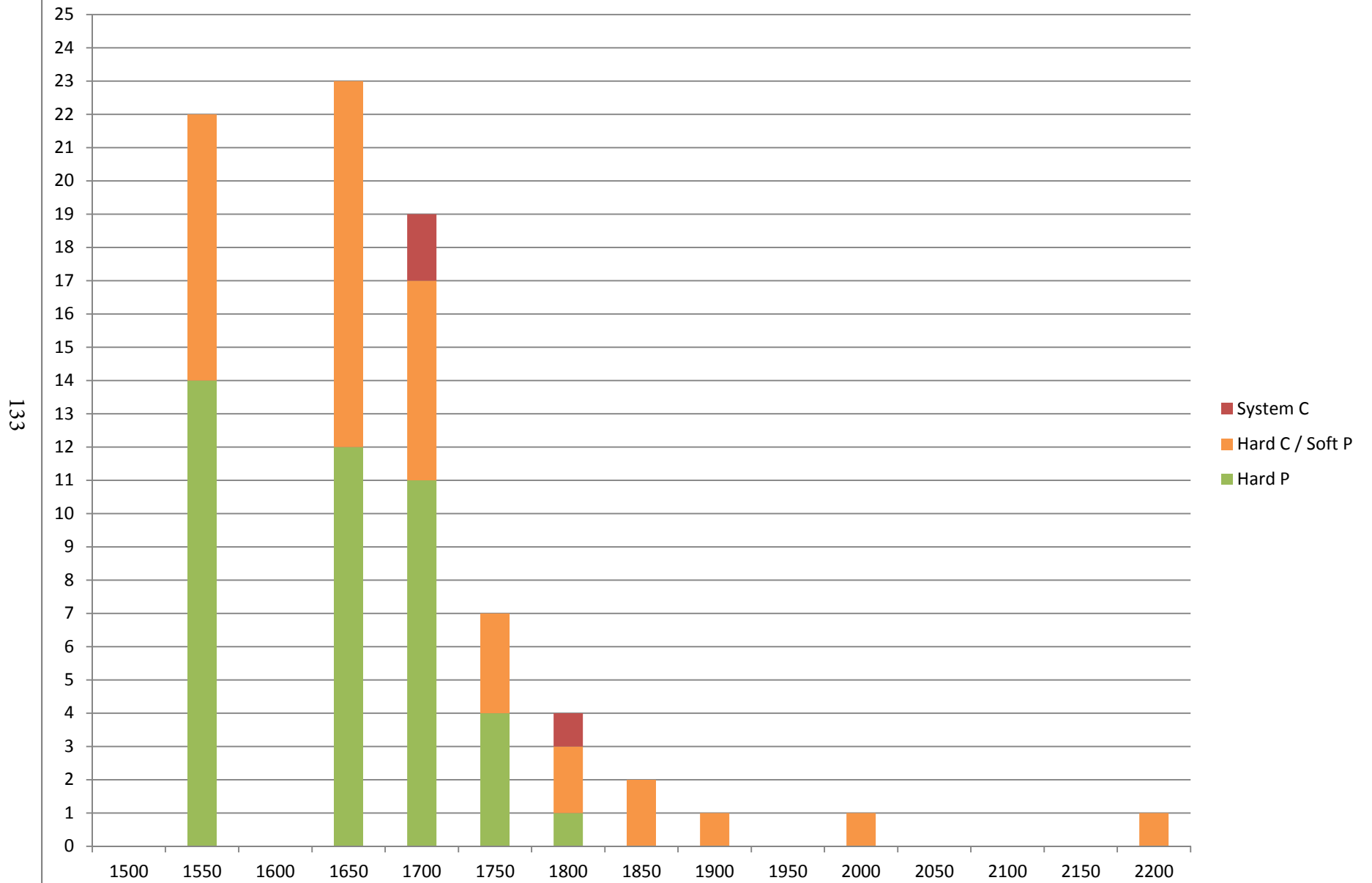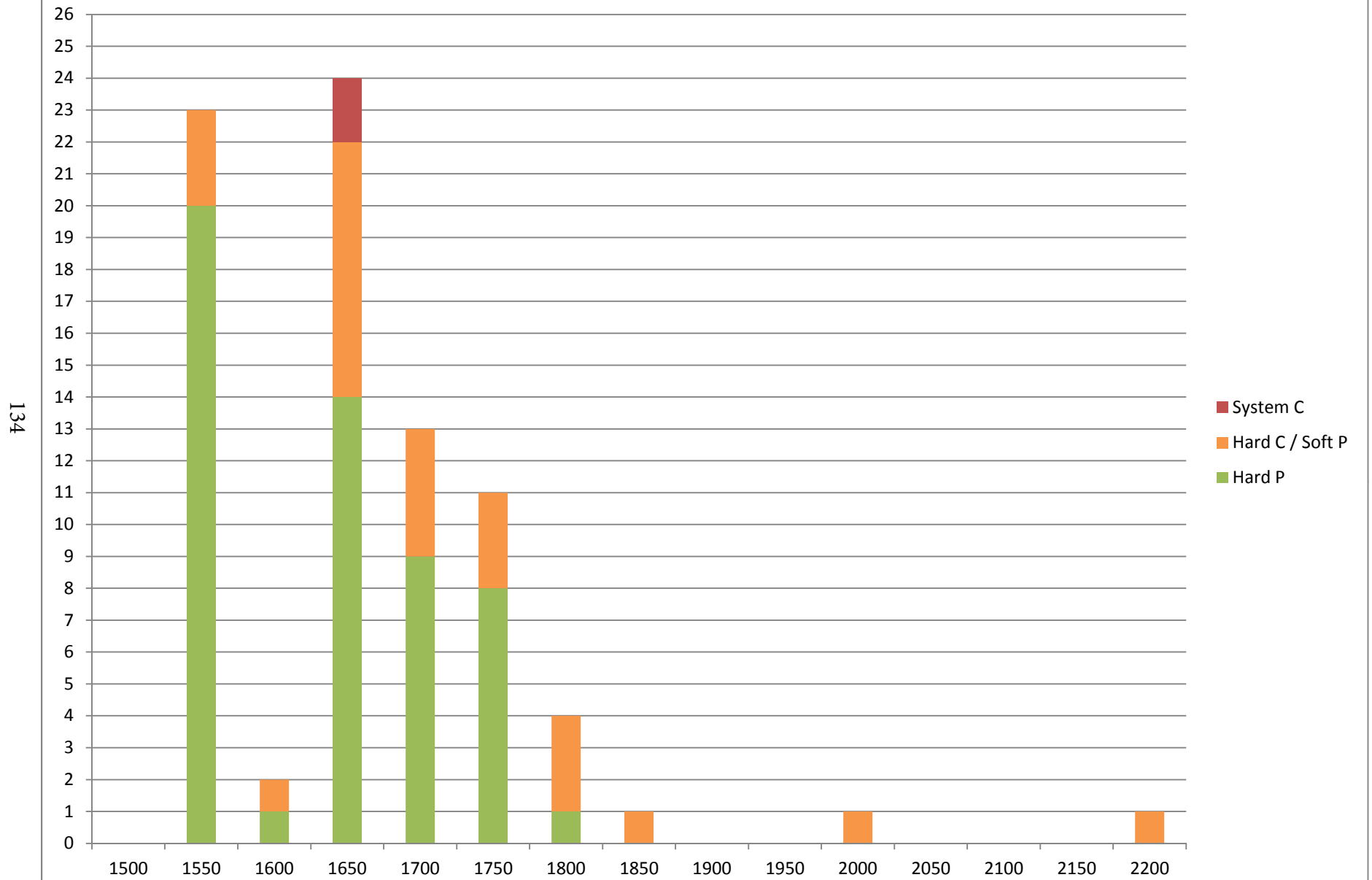
Appendix C. Oneway Analysis of Backface Deformations

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=D, Series=3000
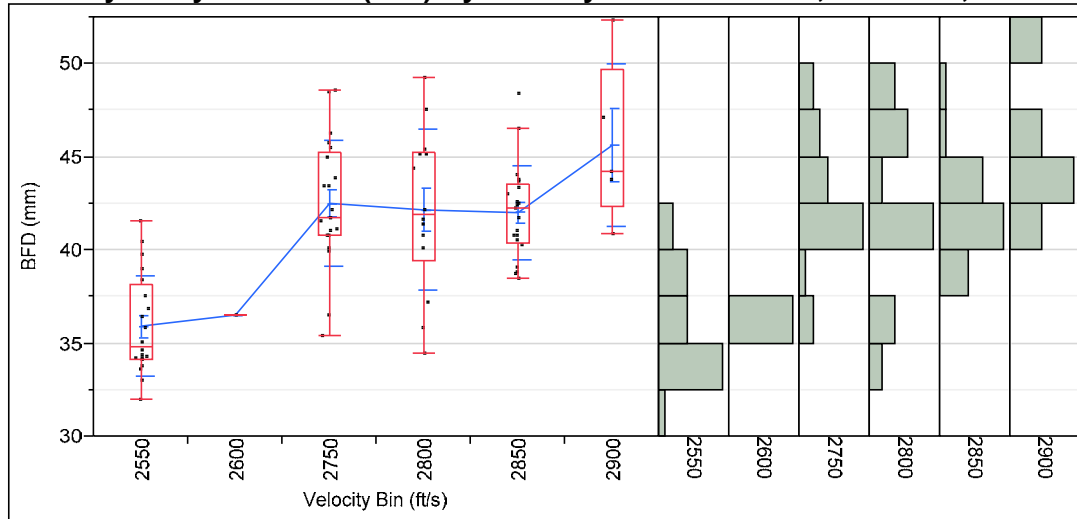
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2550	31.99177	33.03965	34.11175	34.80308	38.15182	40.35834	41.54983
2600	36.53087	36.53087	36.53087	36.53087	36.53087	36.53087	36.53087
2750	35.42109	37.20633	40.7923	41.75459	45.21421	48.02776	48.53555
2800	34.46013	35.15667	39.38633	41.8922	45.2209	48.3924	49.23499
2850	38.47801	38.74458	40.37816	42.2114	43.50743	45.99148	48.36951
2900	40.89743	40.89743	42.31423	44.19365	49.70231	52.32951	52.32951

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2550	20	35.9403	2.68488	0.6004	34.684	37.197
2600	1	36.5309	.	.	.	.
2750	21	42.5252	3.35892	0.7330	40.996	44.054
2800	14	42.1716	4.32364	1.1555	39.675	44.668
2850	21	42.0263	2.50458	0.5465	40.886	43.166
2900	5	45.6453	4.33119	1.9370	40.267	51.023

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=D, Series=3001
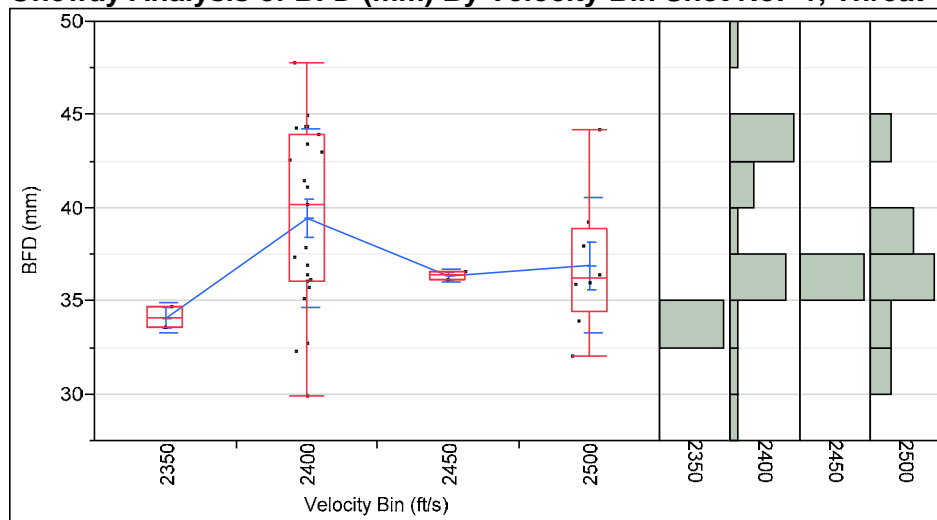
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2350	33.54023	33.54023	33.54023	34.10487	34.6695	34.6695	34.6695
2400	29.89561	32.46283	36.08168	40.13031	43.90855	44.71828	47.75846
2450	36.13091	36.13091	36.13091	36.37021	36.60951	36.60951	36.60951
2500	32.0506	32.0506	34.40942	36.18504	38.9112	44.14142	44.14142

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2350	2	34.1049	0.79852	0.5646	26.930	41.279
2400	23	39.4714	4.77056	0.9947	37.408	41.534
2450	2	36.3702	0.33842	0.2393	33.330	39.411
2500	8	36.9440	3.65433	1.2920	33.889	39.999

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=D, Series=3002

Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1750	18.98309	18.98309	19.06651	19.45425	19.88091	19.97729	19.97729
1800	19.24449	19.48574	20.26047	21.46148	22.54434	23.64311	23.69656
1850	21.65282	21.65282	21.65282	22.17601	22.69921	22.69921	22.69921
1900	19.883	20.4246	21.20138	22.10149	22.903	25.92055	32.047
1950	22.02887	22.02887	22.02887	22.02887	22.02887	22.02887	22.02887

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
1750	4	19.4672	0.42139	0.21069	18.797	20.138
1800	16	21.4267	1.45844	0.36461	20.650	22.204
1850	2	22.1760	0.73991	0.52320	15.528	28.824
1900	31	22.5796	2.52637	0.45375	21.653	23.506
1950	1	22.0289	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=D, Series=3003

Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1100	8.868133	8.888598	10.78226	12.7404	14.16871	14.73398	14.99408
1150	11.75157	11.95382	12.81046	14.47289	16.31452	17.88029	18.01081
1200	12.76629	12.76629	14.45109	15.6949	16.27926	18.9673	18.9673
1250	12.49223	12.82708	14.94879	15.70981	16.93005	20.12755	21.88452
1300	14.067	14.067	15.07958	17.06	19.02187	19.53939	19.53939
1350	14.547	14.74273	15.93373	17.7145	19.09078	21.263	21.30277

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
1100	13	12.2762	2.03055	0.56317	11.049	13.503
1150	11	14.7397	2.05444	0.61944	13.360	16.120
1200	9	15.4643	1.73877	0.57959	14.128	16.801
1250	13	16.0101	2.26456	0.62808	14.642	17.379
1300	8	17.0285	2.08516	0.73722	15.285	18.772
1350	12	17.7359	2.14358	0.61880	16.374	19.098

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=Y, Series=3000
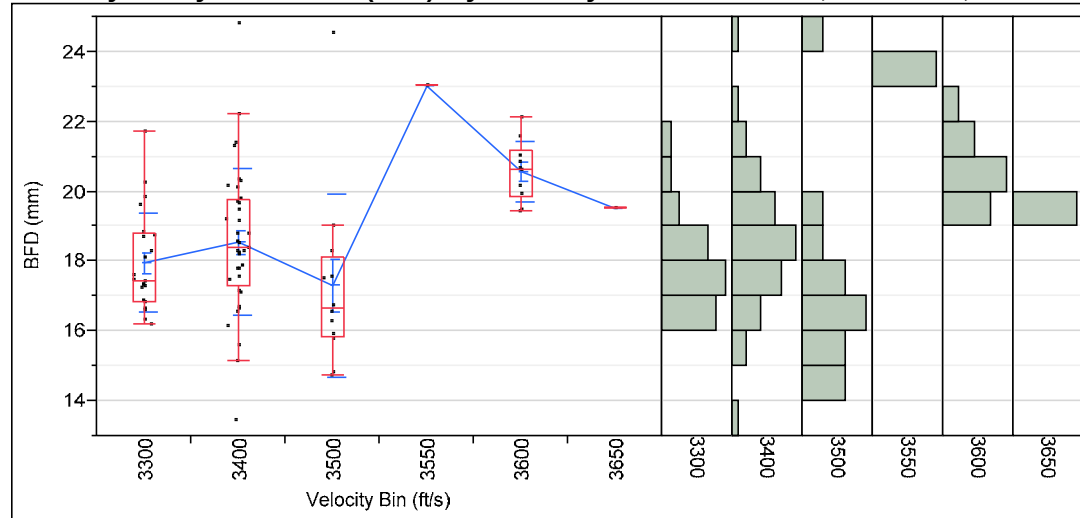
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
3300	16.19467	16.39934	16.84927	17.44188	18.78973	20.13742	21.69337
3400	13.4344	16.04013	17.30332	18.37862	19.76217	21.30787	24.79477
3500	14.72	14.7506	15.832	16.6485	18.108	22.8784	24.526
3550	23.025	23.025	23.025	23.025	23.025	23.025	23.025
3600	19.42	19.4261	19.83425	20.6395	21.15175	22.0639	22.118
3650	19.521	19.521	19.521	19.521	19.521	19.521	19.521

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
3300	22	17.9664	1.41299	0.30125	17.340	18.593
3400	37	18.5588	2.08719	0.34313	17.863	19.255
3500	12	17.3147	2.61463	0.75478	15.653	18.976
3550	1	23.0250	.	.	.	.
3600	10	20.5812	0.86584	0.27380	19.962	21.201
3650	1	19.5210	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=Y, Series=3001
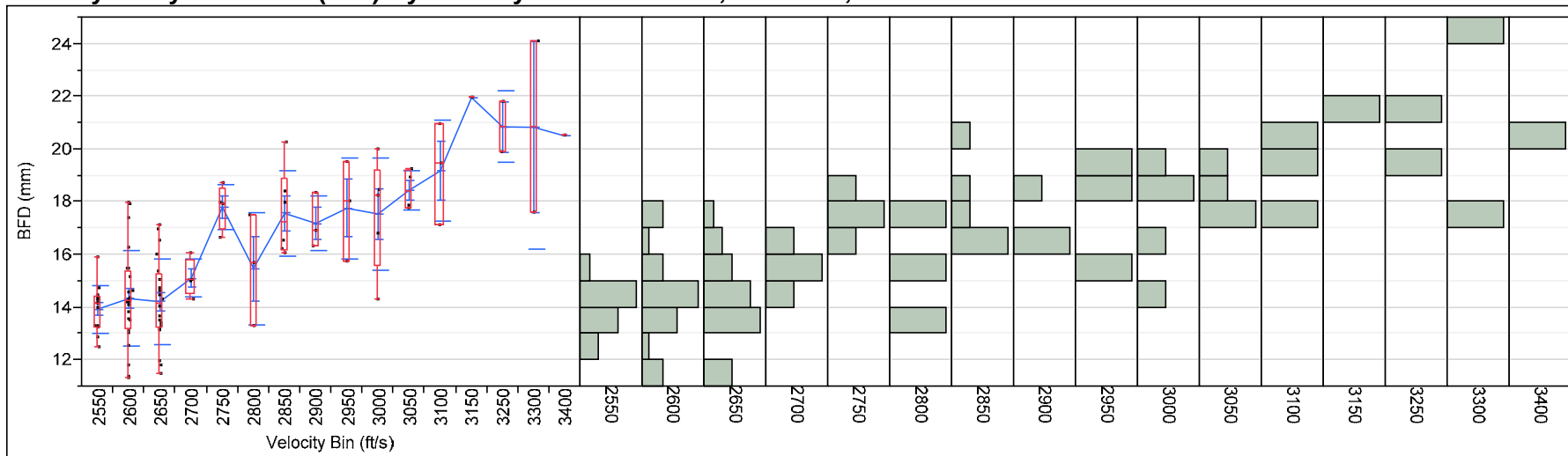
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2550	12.49963	12.63554	13.25918	14.12256	14.4048	15.43082	15.90375
2600	11.3181	11.58099	13.2069	14.22796	15.3877	17.65485	17.9837
2650	11.45573	11.80161	13.21136	14.14296	15.28226	16.90888	17.13558
2700	14.32103	14.32103	14.49345	15.03567	15.8119	16.06232	16.06232
2750	16.66647	16.66647	16.97785	17.93281	18.52353	18.7135	18.7135
2800	13.26419	13.26419	13.26419	15.71	17.502	17.502	17.502
2850	16.043	16.043	16.18475	17.241	18.88025	20.288	20.288
2900	16.31828	16.31828	16.31828	16.905	18.37259	18.37259	18.37259
2950	15.74035	15.74035	15.74035	18.051	19.51451	19.51451	19.51451
3000	14.31577	14.31577	15.5554	18.24735	19.20754	19.977	19.977
3050	17.746	17.746	17.782	18.414	19.18325	19.265	19.265
3100	17.145	17.145	17.145	19.44951	20.97293	20.97293	20.97293
3150	21.971	21.971	21.971	21.971	21.971	21.971	21.971
3250	19.89165	19.89165	19.89165	20.8579	21.82414	21.82414	21.82414
3300	17.57588	17.57588	17.57588	20.83988	24.10388	24.10388	24.10388
3400	20.50939	20.50939	20.50939	20.50939	20.50939	20.50939	20.50939

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2550	13	13.9411	0.90185	0.2501	13.40	14.486
2600	24	14.3443	1.80863	0.3692	13.58	15.108
2650	20	14.2238	1.62647	0.3637	13.46	14.985
2700	4	15.1137	0.71685	0.3584	13.97	16.254
2750	4	17.8114	0.84755	0.4238	16.46	19.160
2800	3	15.4921	2.12729	1.2282	10.21	20.777
2850	6	17.5760	1.64168	0.6702	15.85	19.299
2900	3	17.1986	1.05816	0.6109	14.57	19.827
2950	3	17.7686	1.90286	1.0986	13.04	22.496
3000	5	17.5546	2.13280	0.9538	14.91	20.203
3050	4	18.4598	0.75525	0.3776	17.26	19.662
3100	3	19.1891	1.92720	1.1127	14.40	23.977
3150	1	21.9710	.	.	.	.
3250	2	20.8579	1.36648	0.9662	8.58	33.135
3300	2	20.8399	4.61599	3.2640	-20.63	62.313
3400	1	20.5094	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=Y, Series=3002
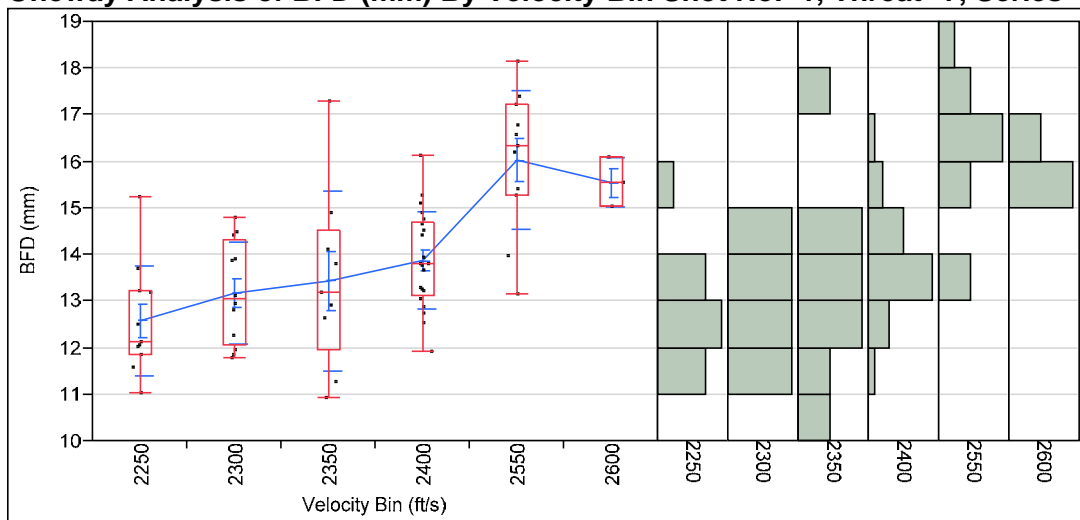
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2250	11.04317	11.1497	11.84791	12.11846	13.21116	14.93907	15.25094
2300	11.76372	11.79045	12.03891	13.03106	14.29796	14.68952	14.77654
2350	10.91474	10.91474	11.94353	13.18224	14.50648	17.29619	17.29619
2400	11.91759	12.57328	13.12772	13.78489	14.69906	15.24461	16.13254
2550	13.146	13.3118	15.271	16.328	17.215	17.9948	18.144
2600	15.027	15.027	15.027	15.536	16.098	16.098	16.098

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2250	11	12.5895	1.17740	0.35500	11.798	13.380
2300	12	13.1800	1.09007	0.31468	12.487	13.873
2350	9	13.4416	1.92742	0.64247	11.960	14.923
2400	21	13.8829	1.03774	0.22645	13.411	14.355
2550	11	16.0384	1.49048	0.44940	15.037	17.040
2600	3	15.5537	0.53572	0.30930	14.223	16.884

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=Y, Series=3003
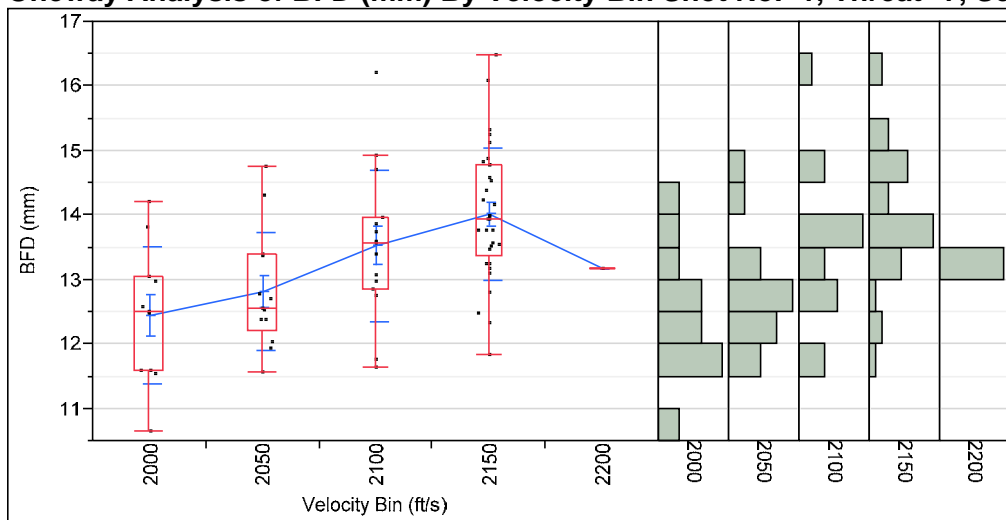
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2000	10.65622	10.83331	11.58613	12.49338	13.04067	14.13609	14.21731
2050	11.5638	11.711	12.19857	12.56072	13.38241	14.56846	14.74541
2100	11.64088	11.70887	12.858	13.57683	13.96081	15.44405	16.22021
2150	11.83853	12.60134	13.35585	13.94486	14.77086	15.2891	16.4762
2200	13.181	13.181	13.181	13.181	13.181	13.181	13.181

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2000	11	12.4491	1.05508	0.31812	11.740	13.158
2050	13	12.8195	0.91763	0.25450	12.265	13.374
2100	15	13.5346	1.17190	0.30258	12.886	14.184
2150	33	14.0231	1.02273	0.17803	13.660	14.386
2200	1	13.1810	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=D, Series=3000
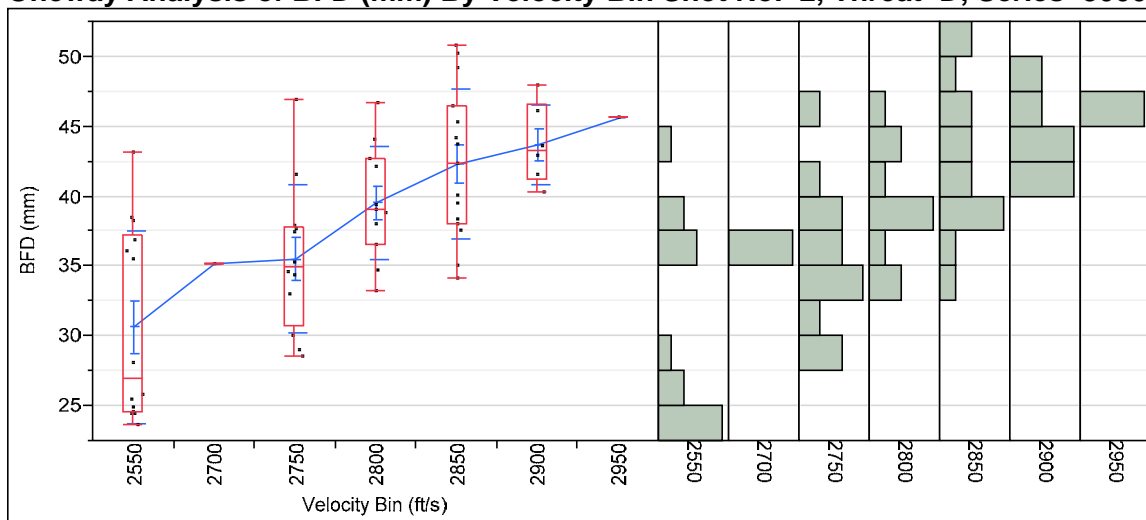
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2550	23.59971	24.00148	24.55347	26.94447	37.21121	40.82186	43.17854
2700	35.20611	35.20611	35.20611	35.20611	35.20611	35.20611	35.20611
2750	28.53247	28.6672	30.7493	34.92822	37.83483	45.33717	46.9532
2800	33.17144	33.48146	36.51289	39.08213	42.68801	46.11015	46.62905
2850	34.15955	34.66837	38.01977	42.367	46.49795	50.39786	50.7339
2900	40.25844	40.25844	41.20608	43.21417	46.61438	47.95418	47.95418
2950	45.6149	45.6149	45.6149	45.6149	45.6149	45.6149	45.6149

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2550	14	30.6761	6.91254	1.8475	26.685	34.667
2700	1	35.2061	.	.	.	.
2750	12	35.5291	5.32673	1.5377	32.145	38.914
2800	11	39.5654	4.03396	1.2163	36.855	42.275
2850	15	42.3236	5.34857	1.3810	39.362	45.286
2900	6	43.7218	2.88034	1.1759	40.699	46.745
2950	1	45.6149	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=D, Series=3001
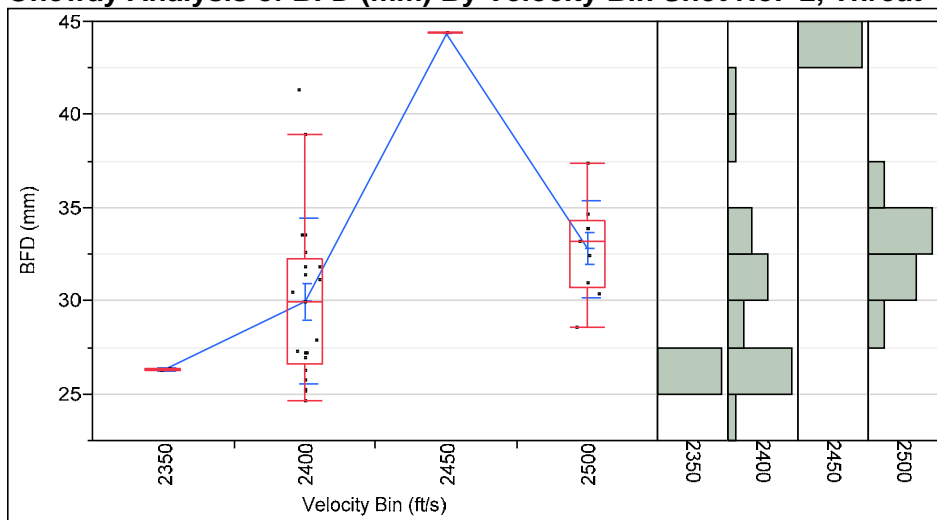
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2350	26.28454	26.28454	26.28454	26.33154	26.37854	26.37854	26.37854
2400	24.65239	25.20604	26.58943	29.95349	32.21647	37.8399	41.32719
2450	44.36635	44.36635	44.36635	44.36635	44.36635	44.36635	44.36635
2500	28.60589	28.60589	30.6943	33.18368	34.29733	37.40706	37.40706

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2350	2	26.3315	0.06647	0.04700	25.734	26.929
2400	21	30.0070	4.43183	0.96710	27.990	32.024
2450	1	44.3663	.	.	.	.
2500	9	32.8292	2.59843	0.86614	30.832	34.827

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=D, Series=3002

Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1750	18.98309	18.98309	19.06651	19.45425	19.88091	19.97729	19.97729
1800	19.24449	19.48574	20.26047	21.46148	22.54434	23.64311	23.69656
1850	21.65282	21.65282	21.65282	22.17601	22.69921	22.69921	22.69921
1900	19.883	20.4246	21.20138	22.10149	22.903	25.92055	32.047
1950	22.02887	22.02887	22.02887	22.02887	22.02887	22.02887	22.02887

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
1750	4	19.4672	0.42139	0.21069	18.797	20.138
1800	16	21.4267	1.45844	0.36461	20.650	22.204
1850	2	22.1760	0.73991	0.52320	15.528	28.824
1900	31	22.5796	2.52637	0.45375	21.653	23.506
1950	1	22.0289	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=D, Series=3003

Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1100	5.718689	6.027468	7.528996	9.233364	10.68146	12.00981	12.13919
1150	6.121844	8.098303	9.628151	11.05267	11.57078	12.53409	12.99162
1200	8.172888	8.183006	9.701366	11.60599	12.49559	14.34077	14.6296
1250	11.02121	11.19643	12.459	13.53512	14.101	15.301	15.58131
1300	13.799	13.799	14.80531	15.103	15.54022	16.45498	16.45498
1350	12.813	13.02275	14.20499	15.19754	17.04241	19.25521	19.67643

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
1100	11	9.2853	1.95964	0.59085	7.969	10.602
1150	15	10.7424	1.60891	0.41542	9.851	11.633
1200	11	11.3779	1.99787	0.60238	10.036	12.720
1250	11	13.3020	1.25594	0.37868	12.458	14.146
1300	7	15.1259	0.80571	0.30453	14.381	15.871
1350	14	15.6346	2.00511	0.53589	14.477	16.792

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=Y, Series=3000
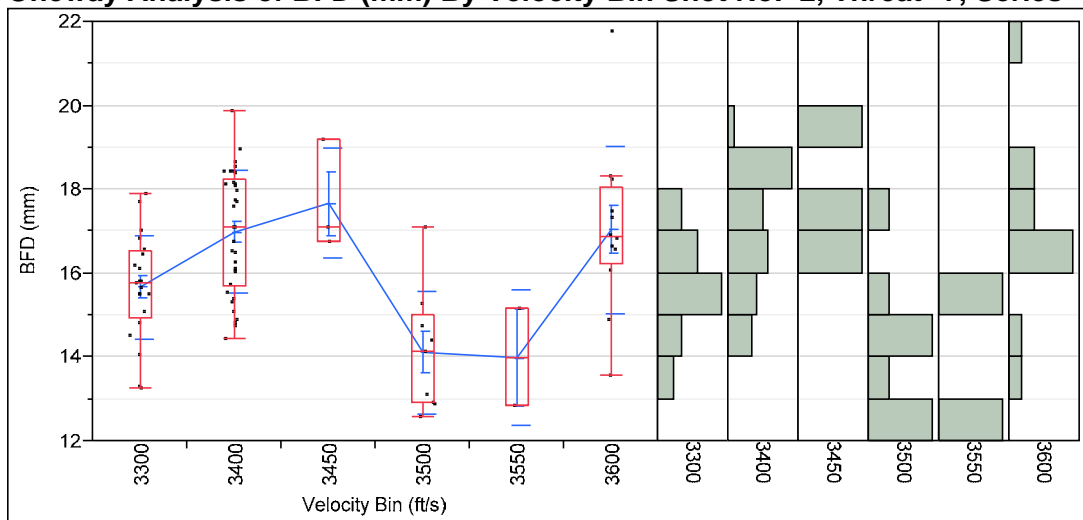
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
3300	13.26852	13.45745	14.94599	15.77116	16.51047	17.57158	17.90531
3400	14.44721	14.83864	15.69448	17.08691	18.22612	18.60132	19.88082
3450	16.73941	16.73941	16.73941	17.10585	19.19358	19.19358	19.19358
3500	12.577	12.577	12.905	14.113	14.9965	17.107	17.107
3550	12.84	12.84	12.84	13.9945	15.149	15.149	15.149
3600	13.572	13.9674	16.20175	16.861	18.05475	20.7232	21.757

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
3300	21	15.6822	1.23944	0.2705	15.12	16.246
3400	34	16.9868	1.45905	0.2502	16.48	17.496
3450	3	17.6796	1.32388	0.7643	14.39	20.968
3500	9	14.1197	1.46001	0.4867	13.00	15.242
3550	2	13.9945	1.63271	1.1545	-0.67	28.664
3600	12	17.0489	1.99109	0.5748	15.78	18.314

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=Y, Series=3001
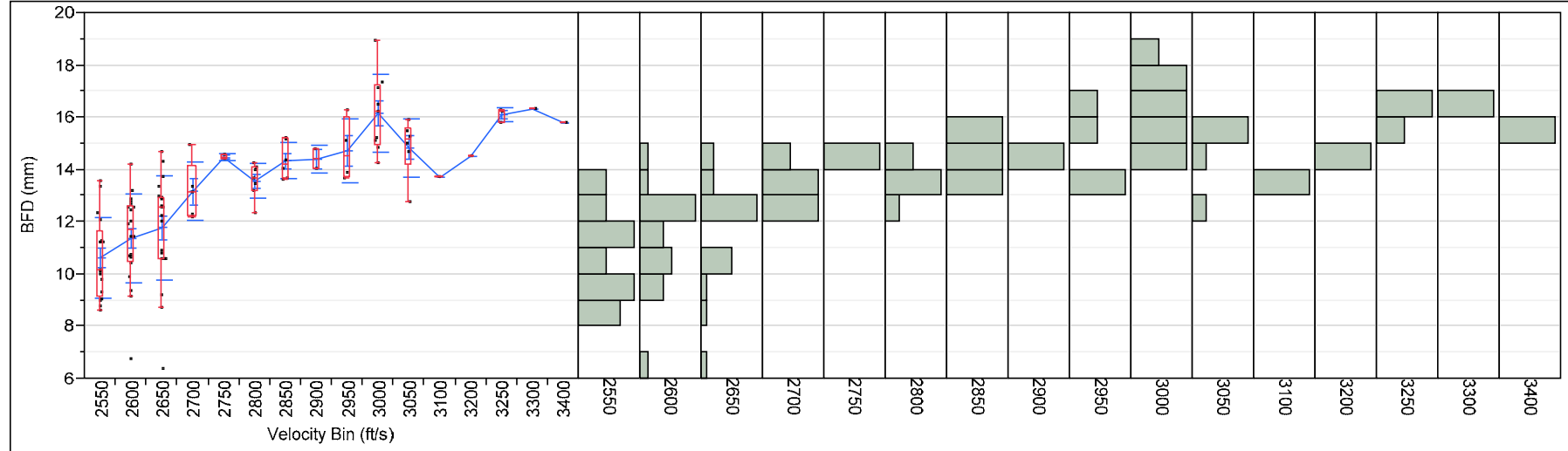
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2550	8.596518	8.733772	9.159473	10.13753	11.65574	13.37877	13.54357
2600	6.759438	9.16759	10.48035	11.67747	12.62014	13.15993	14.2054
2650	6.376214	8.80584	10.58725	12.5461	12.94148	14.19729	14.67295
2700	12.1549	12.1549	12.22219	13.13931	14.15799	14.96941	14.96941
2750	14.3883	14.3883	14.3883	14.47515	14.562	14.562	14.562
2800	12.31491	12.31491	13.163	13.679	14.11456	14.244	14.244
2850	13.633	13.633	13.6659	14.1995	15.18402	15.22306	15.22306
2900	14.028	14.028	14.028	14.40386	14.77973	14.77973	14.77973
2950	13.673	13.673	13.7275	14.49587	15.98219	16.276	16.276
3000	14.25385	14.25385	14.96	16.21436	17.23222	18.95235	18.95235
3050	12.75669	12.75669	14.18942	15.142	15.56775	15.876	15.876
3100	13.70854	13.70854	13.70854	13.70854	13.70854	13.70854	13.70854
3200	14.52577	14.52577	14.52577	14.52577	14.52577	14.52577	14.52577
3250	15.8087	15.8087	15.8087	16.23705	16.2817	16.2817	16.2817
3300	16.32691	16.32691	16.32691	16.32691	16.32691	16.32691	16.32691
3400	15.80432	15.80432	15.80432	15.80432	15.80432	15.80432	15.80432

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2550	17	10.6419	1.55139	0.37627	9.844	11.440
2600	20	11.3808	1.72429	0.38556	10.574	12.188
2650	21	11.7804	1.99553	0.43546	10.872	12.689
2700	5	13.1799	1.12642	0.50375	11.781	14.579
2750	2	14.4751	0.12283	0.08685	13.372	15.579
2800	7	13.5665	0.66957	0.25307	12.947	14.186
2850	6	14.3505	0.70789	0.28900	13.608	15.093
2900	2	14.4039	0.53155	0.37586	9.628	19.180
2950	4	14.7352	1.20397	0.60199	12.819	16.651
3000	9	16.1664	1.48643	0.49548	15.024	17.309
3050	6	14.8414	1.09965	0.44893	13.687	15.995
3100	1	13.7085	.	.	.	.
3200	1	14.5258	.	.	.	.
3250	3	16.1092	0.26115	0.15078	15.460	16.758
3300	1	16.3269	.	.	.	.
3400	1	15.8043	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=Y, Series=3002
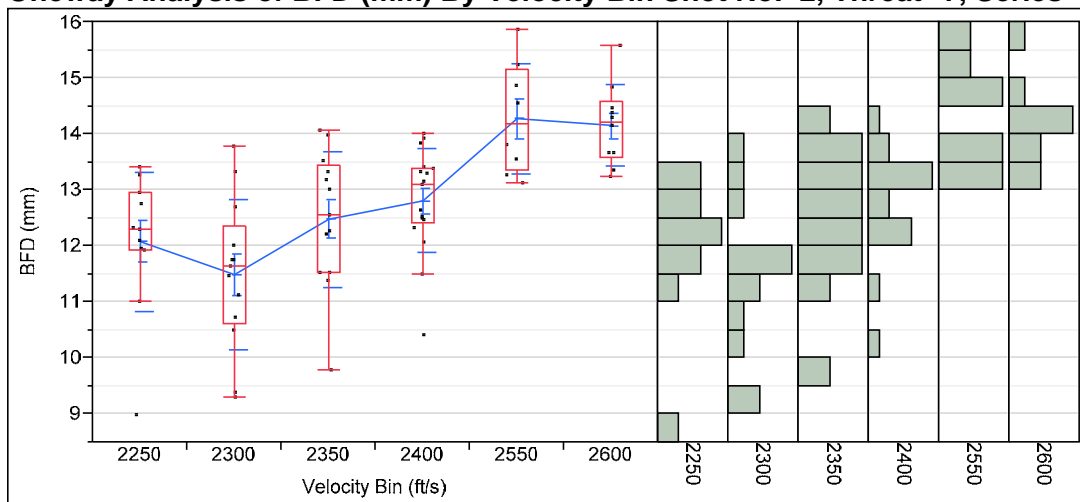
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2250	8.994975	9.396723	11.91381	12.28053	12.95238	13.38355	13.41331
2300	9.2961	9.331318	10.60816	11.6489	12.34616	13.59107	13.76875
2350	9.785978	10.4194	11.52111	12.55628	13.4213	14.03337	14.06844
2400	10.42401	11.27343	12.39961	13.08482	13.37833	13.94761	14.01587
2550	13.12	13.12	13.34225	14.178	15.1385	15.851	15.851
2600	13.22	13.2321	13.58325	14.214	14.56675	15.4984	15.571

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2250	11	12.0836	1.23389	0.37203	11.255	12.913
2300	13	11.4954	1.33548	0.37040	10.688	12.302
2350	13	12.4834	1.21647	0.33739	11.748	13.219
2400	17	12.8134	0.92396	0.22409	12.338	13.288
2550	8	14.2798	0.99062	0.35024	13.452	15.108
2600	10	14.1587	0.71966	0.22758	13.644	14.674

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=Y, Series=3003
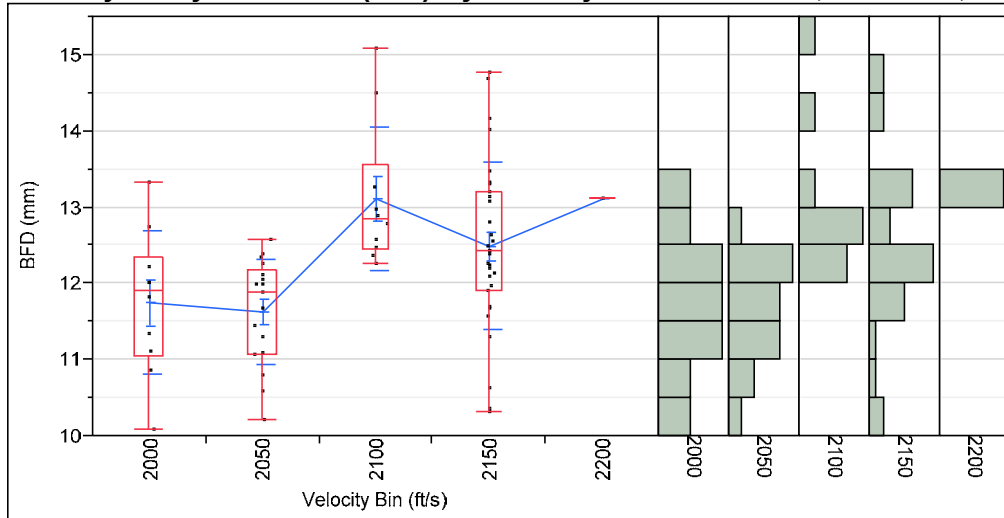
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2000	10.07349	10.15261	11.05027	11.91192	12.3447	13.27252	13.3306
2050	10.20643	10.51153	11.06918	11.87789	12.18306	12.42653	12.57043
2100	12.26813	12.27672	12.43664	12.84126	13.56388	15.02545	15.08439
2150	10.324	10.7576	11.90664	12.42088	13.19194	14.13114	14.75831
2200	13.11	13.11	13.11	13.11	13.11	13.11	13.11

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2000	10	11.7518	0.94394	0.29850	11.077	12.427
2050	17	11.6301	0.69210	0.16786	11.274	11.986
2100	10	13.1141	0.94281	0.29814	12.440	13.789
2150	31	12.4899	1.09848	0.19729	12.087	12.893
2200	1	13.1100	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=D, Series=3004
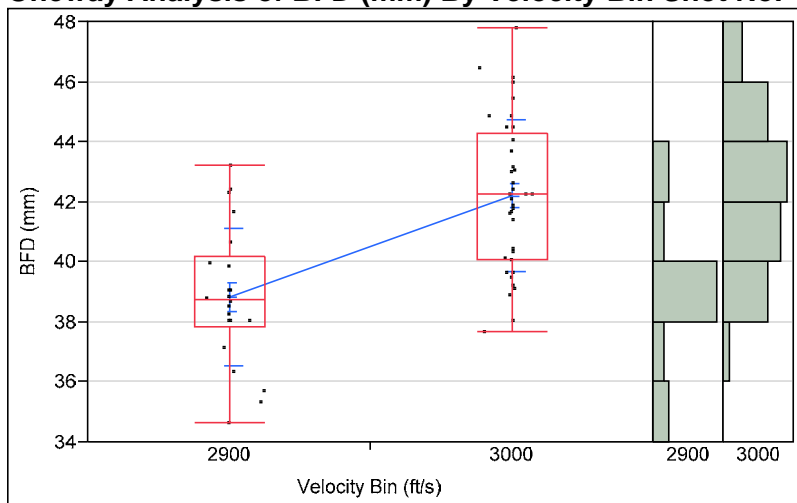
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2900	34.64685	35.45321	37.8061	38.73641	40.15097	42.39663	43.18919
3000	37.69768	39.07041	40.07731	42.23988	44.25241	45.99182	47.78799

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2900	22	38.8476	2.27398	0.48481	37.839	39.856
3000	37	42.2242	2.50884	0.41245	41.388	43.061

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=D, Series=3005
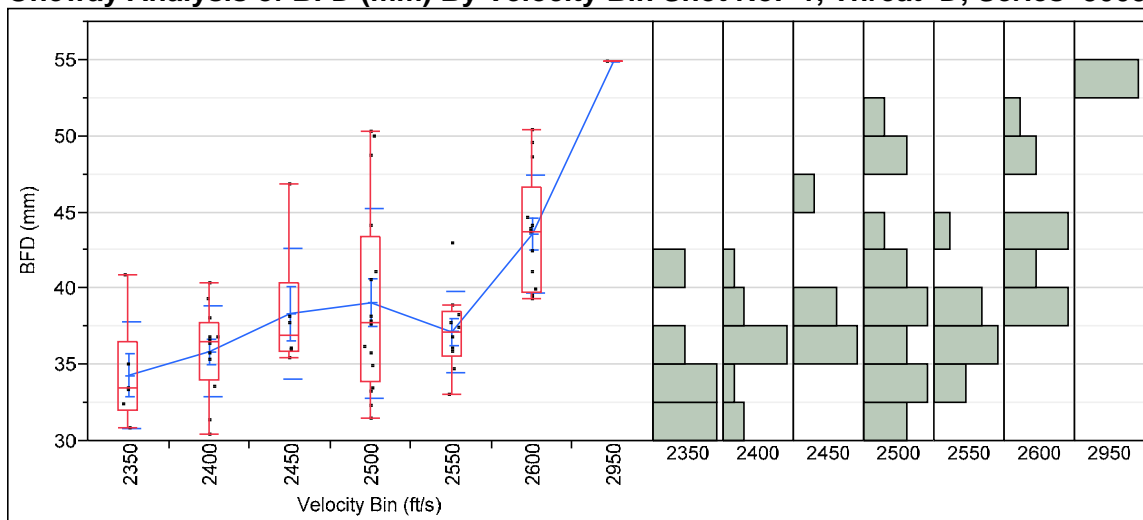
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2350	30.80169	30.80169	31.99063	33.44058	36.47564	40.88357	40.88357
2400	30.3665	30.65361	34.00109	36.49326	37.74688	40.05926	40.38601
2450	35.42596	35.42596	35.84702	36.93158	40.34695	46.86441	46.86441
2500	31.47112	32.0368	33.81731	37.72208	43.39351	50.0413	50.2615
2550	33.05602	33.22177	35.53788	37.10963	38.45686	42.52185	42.9231
2600	39.28141	39.37164	39.75697	43.73	46.6735	50.0706	50.381
2950	54.89311	54.89311	54.89311	54.89311	54.89311	54.89311	54.89311

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2350	6	34.3266	3.49913	1.4285	30.655	37.999
2400	12	35.8856	2.95480	0.8530	34.008	37.763
2450	6	38.3859	4.29257	1.7524	33.881	42.891
2500	16	39.0919	6.22008	1.5550	35.777	42.406
2550	10	37.1672	2.66813	0.8437	35.259	39.076
2600	13	43.6063	3.89460	1.0802	41.253	45.960
2950	1	54.8931	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=D, Series=3006
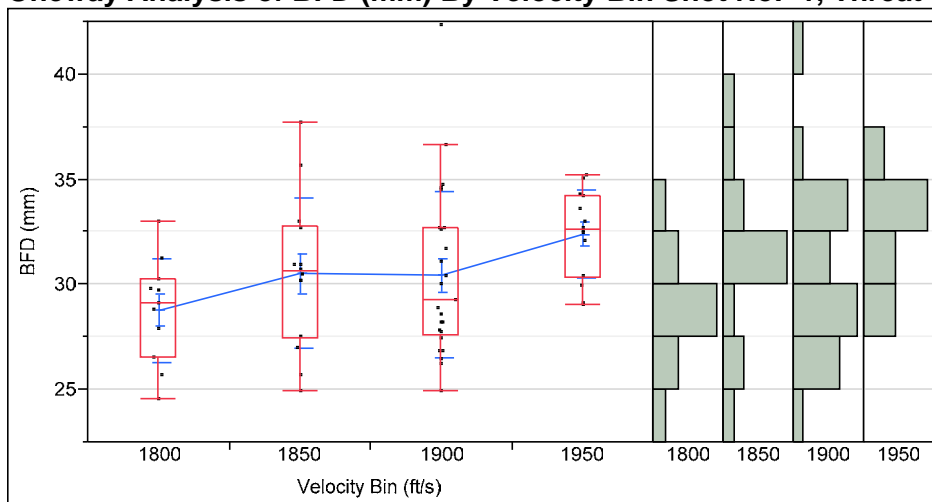
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1800	24.58867	24.8036	26.53583	29.09696	30.28532	32.66992	33.02037
1850	24.94276	25.33385	27.41221	30.60064	32.79324	36.6737	37.67893
1900	24.96801	26.36993	27.61668	29.2988	32.70061	35.48152	42.31913
1950	29.07225	29.07762	30.31241	32.61603	34.22577	35.15082	35.23245

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
1800	11	28.7870	2.48177	0.74828	27.120	30.454
1850	14	30.5522	3.56003	0.95146	28.497	32.608
1900	25	30.4693	3.96996	0.79399	28.831	32.108
1950	14	32.4063	2.07246	0.55389	31.210	33.603

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=D, Series=3007
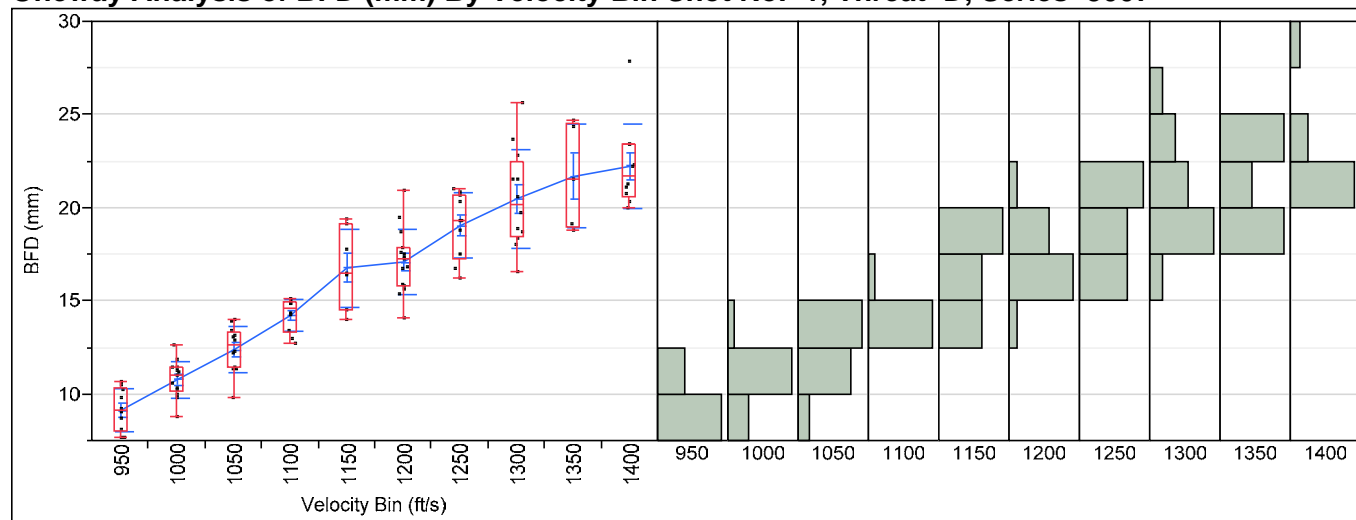
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
950	7.67232	7.673241	7.995299	9.09477	10.33171	10.6355	10.64789
1000	8.757169	9.175589	10.12537	11.03346	11.43628	12.31766	12.63272
1050	9.841897	10.28382	11.40685	12.59928	13.34652	13.99814	14.02541
1100	12.75687	12.78132	13.31899	14.60406	14.9563	15.08392	15.09346
1150	14.01935	14.01935	14.53712	16.47951	19.13065	19.38357	19.38357
1200	14.07026	14.8389	15.75826	17.24728	17.85451	20.05889	20.93957
1250	16.25838	16.30698	17.2942	19.31975	20.6947	21.01946	21.03491
1300	16.60918	17.04122	18.46536	20.1659	22.50471	25.06063	25.65679
1350	18.82704	18.82704	18.97354	21.54589	24.52398	24.71049	24.71049
1400	20.01445	20.04648	20.62915	21.72665	23.40542	27.42224	27.86398

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
950	10	9.1622	1.12963	0.3572	8.354	9.970
1000	13	10.8121	1.00301	0.2782	10.206	11.418
1050	12	12.4170	1.24127	0.3583	11.628	13.206
1100	10	14.2585	0.87874	0.2779	13.630	14.887
1150	7	16.8167	2.08882	0.7895	14.885	18.749
1200	15	17.1243	1.73291	0.4474	16.165	18.084
1250	10	19.0789	1.73948	0.5501	17.835	20.323
1300	12	20.5191	2.63235	0.7599	18.847	22.192
1350	5	21.7082	2.78176	1.2440	18.254	25.162
1400	10	22.2601	2.29988	0.7273	20.615	23.905

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=X, Series=3004
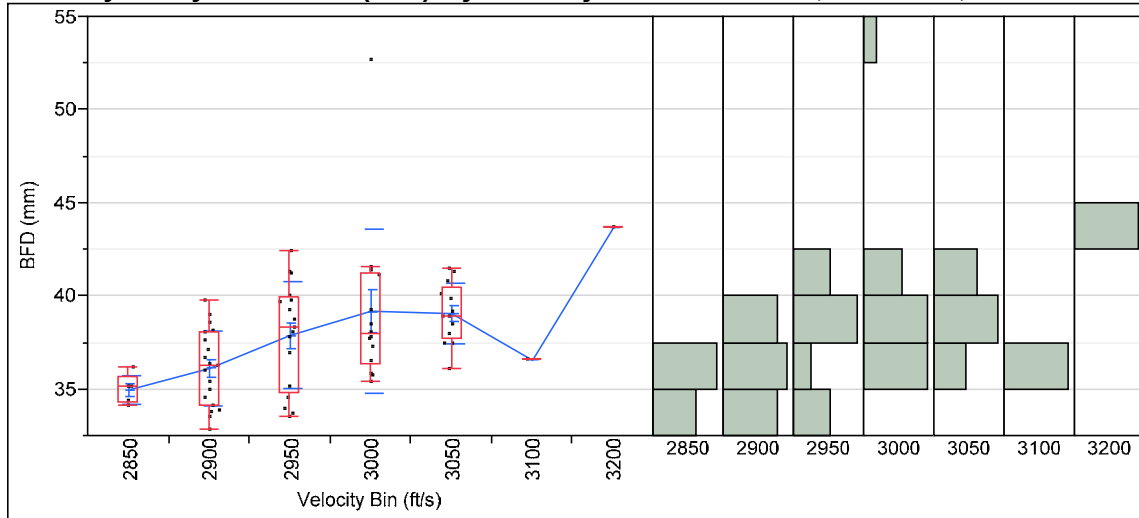
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2850	34.12763	34.12763	34.26854	35.1209	35.64445	36.16264	36.16264
2900	32.85894	33.50277	34.10698	36.27006	38.01822	38.99045	39.75695
2950	33.48522	33.66232	34.83907	38.35769	39.90395	41.55697	42.42074
3000	35.413	35.5825	36.33775	37.93649	41.20364	47.1215	52.675
3050	36.107	36.6398	37.7285	38.896	40.466	41.43465	41.51842
3100	36.57456	36.57456	36.57456	36.57456	36.57456	36.57456	36.57456
3200	43.67962	43.67962	43.67962	43.67962	43.67962	43.67962	43.67962

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2850	5	34.9894	0.78923	0.3530	34.009	35.969
2900	19	36.1384	2.04558	0.4693	35.152	37.124
2950	17	37.9125	2.84940	0.6911	36.447	39.378
3000	14	39.2108	4.38544	1.1721	36.679	41.743
3050	13	39.0808	1.61749	0.4486	38.103	40.058
3100	1	36.5746	.	.	.	.
3200	1	43.6796	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=X, Series=3005
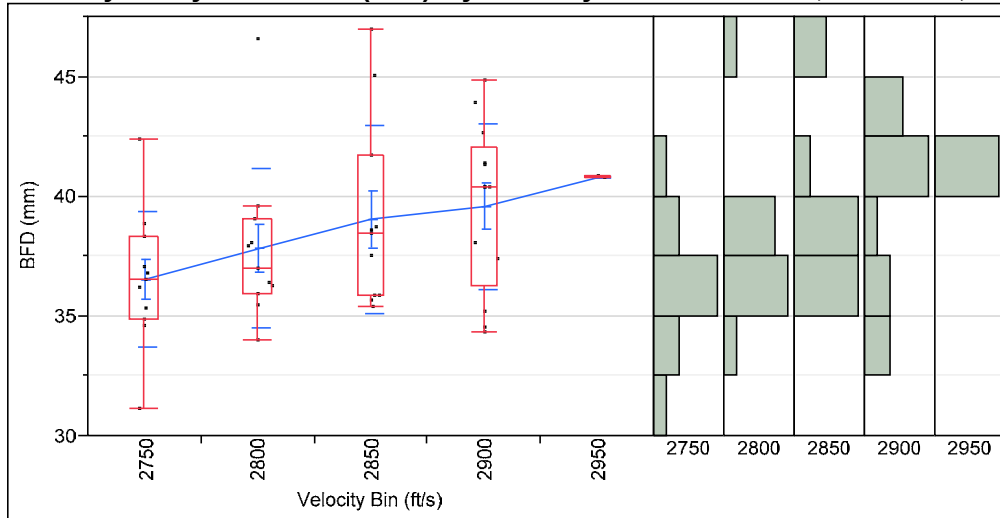
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2750	31.11954	31.82021	34.87233	36.52288	38.30551	41.68427	42.39977
2800	33.96417	34.26804	35.92435	36.97367	39.0433	45.17012	46.56271
2850	35.36165	35.41617	35.8398	38.48358	41.71414	46.59056	46.97068
2900	34.34043	34.40228	36.27664	40.386	42.01976	44.46122	44.834
2950	40.789	40.789	40.789	40.8015	40.814	40.814	40.814

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2750	11	36.5528	2.83491	0.8548	34.648	38.457
2800	11	37.8260	3.32243	1.0017	35.594	40.058
2850	11	39.0699	3.93515	1.1865	36.426	41.714
2900	13	39.5894	3.46081	0.9599	37.498	41.681
2950	2	40.8015	0.01768	0.0125	40.643	40.960

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=X, Series=3006
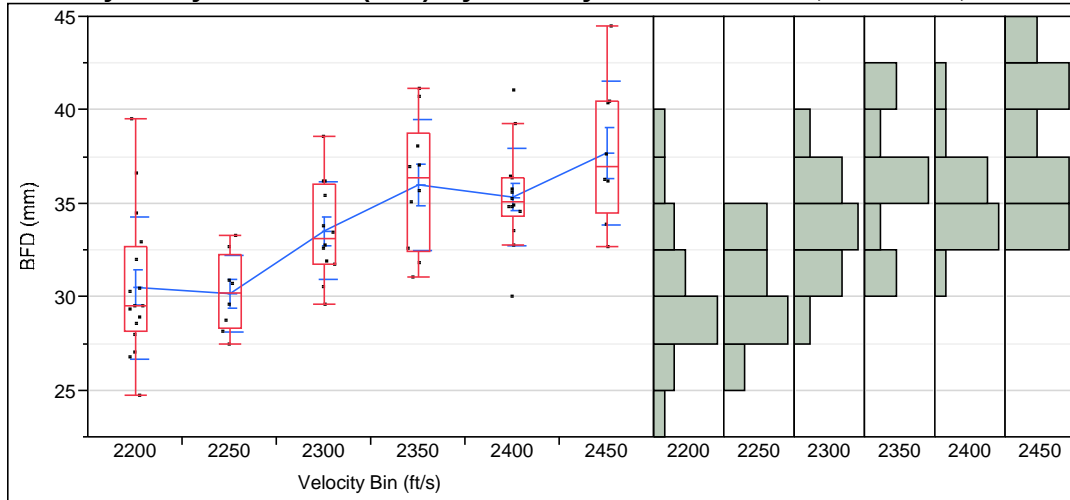
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2200	24.73674	26.15095	28.15123	29.52172	32.71883	37.45504	39.49323
2250	27.49718	27.49718	28.31704	30.16918	32.25864	33.26702	33.26702
2300	29.61025	29.88944	31.76375	33.11621	35.98904	37.90418	38.62487
2350	31.07804	31.15202	32.40884	36.34919	38.72388	41.0936	41.13404
2400	30.00311	31.38355	34.32869	35.10516	36.35821	40.14142	41.04154
2450	32.72108	32.72108	34.44399	36.96173	40.43729	44.47552	44.47552

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2200	16	30.5394	3.80499	0.9512	28.512	32.567
2250	8	30.2048	2.08340	0.7366	28.463	31.947
2300	12	33.5653	2.62083	0.7566	31.900	35.230
2350	10	36.0291	3.48283	1.1014	33.538	38.521
2400	14	35.3666	2.62700	0.7021	33.850	36.883
2450	8	37.7481	3.86417	1.3662	34.518	40.979

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=1, Threat=X, Series=3007
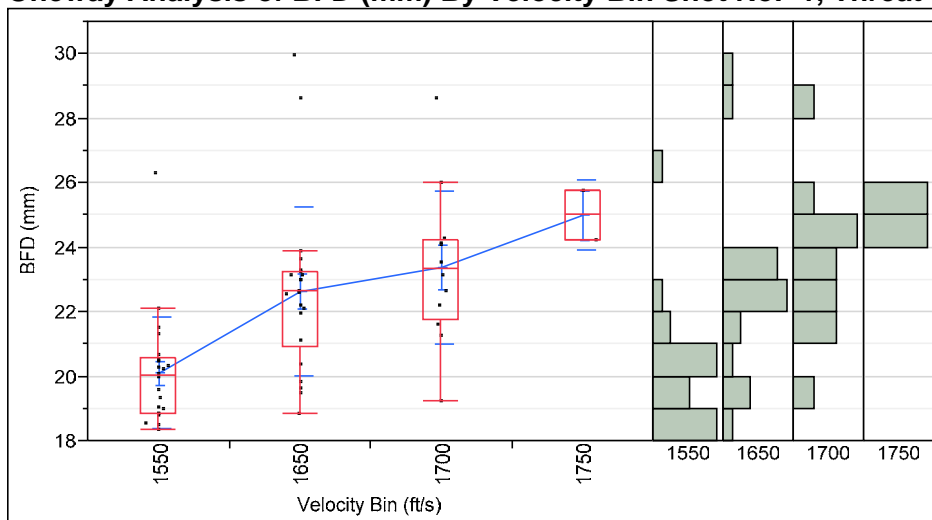
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1550	18.35955	18.48725	18.8337	20.03696	20.55367	21.9209	26.28417
1650	18.83812	19.52504	20.93021	22.62358	23.24065	27.19277	29.9623
1700	19.22217	19.83061	21.76108	23.32827	24.23241	27.82534	28.61111
1750	24.23927	24.23927	24.23927	25.00898	25.7787	25.7787	25.7787

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
1550	22	20.1141	1.73007	0.36885	19.347	20.881
1650	22	22.6409	2.61246	0.55698	21.483	23.799
1700	12	23.3928	2.39216	0.69056	21.873	24.913
1750	2	25.0090	1.08854	0.76971	15.229	34.789

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=D, Series=3004
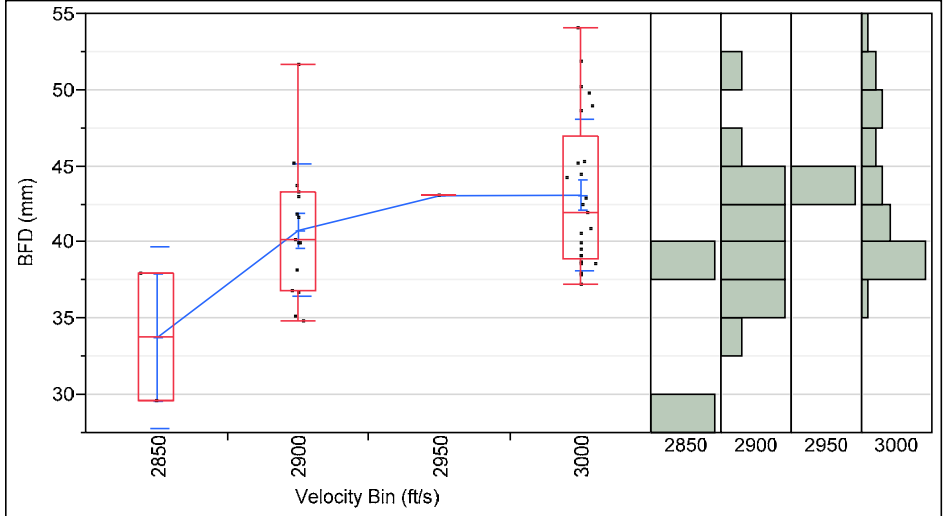
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2850	29.55185	29.55185	29.55185	33.77392	37.996	37.996	37.996
2900	34.85915	35.02329	36.85121	40.15024	43.29169	47.74557	51.61839
2950	43.08574	43.08574	43.08574	43.08574	43.08574	43.08574	43.08574
3000	37.22506	37.91235	38.9171	41.95096	46.98802	50.90134	54.00893

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2850	2	33.7739	5.97092	4.2221	-19.87	87.420
2900	15	40.8036	4.35497	1.1244	38.39	43.215
2950	1	43.0857	.	.	.	.
3000	25	43.1131	4.93386	0.9868	41.08	45.150

## Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=D, Series=3005
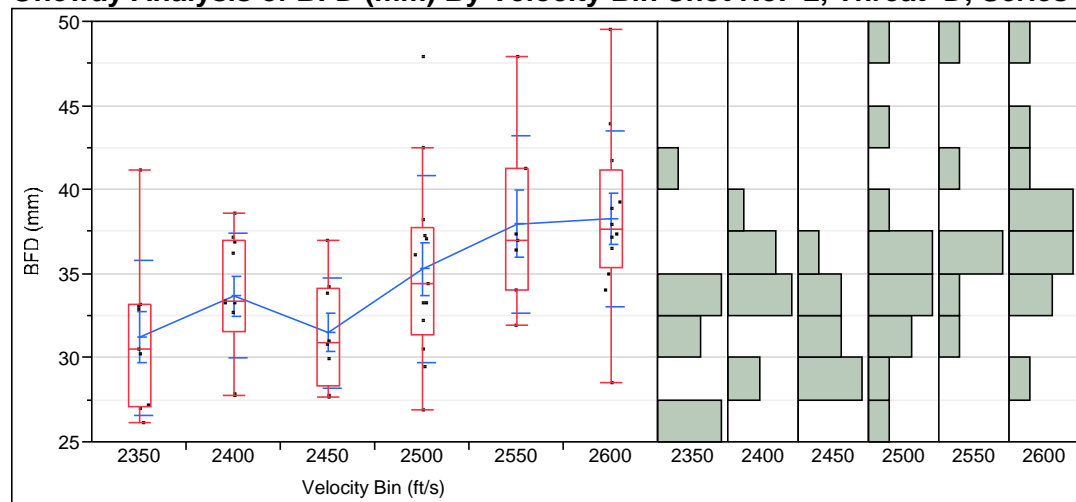
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2350	26.16917	26.16917	27.09671	30.48208	33.13409	41.16359	41.16359
2400	27.79875	27.80677	31.52071	33.32484	36.9784	38.4829	38.62898
2450	27.6254	27.6254	28.31667	30.90985	34.16906	36.99063	36.99063
2500	26.87507	27.89705	31.37456	34.36907	37.76386	45.74348	47.89865
2550	31.90949	31.90949	34.06368	36.96427	41.27416	47.93281	47.93281
2600	28.53217	30.18388	35.34977	37.63363	41.14198	47.80562	49.481

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2350	9	31.2659	4.60942	1.5365	27.723	34.809
2400	10	33.7264	3.69877	1.1697	31.080	36.372
2450	8	31.5404	3.28358	1.1609	28.795	34.286
2500	13	35.3176	5.58148	1.5480	31.945	38.690
2550	7	37.9862	5.26094	1.9884	33.121	42.852
2600	12	38.3156	5.22161	1.5073	34.998	41.633

## Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=D, Series=3006
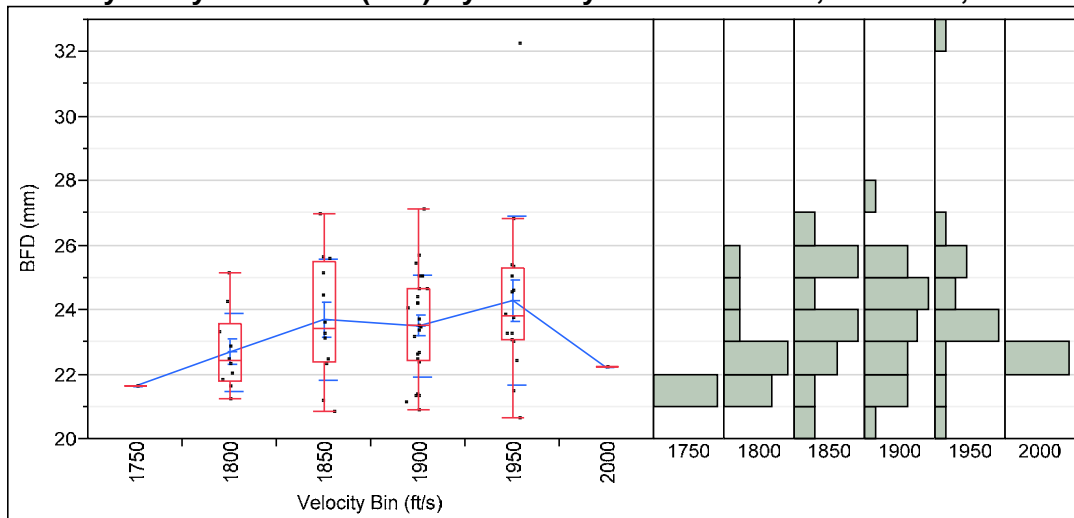
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1750	21.65541	21.65541	21.65541	21.65541	21.65541	21.65541	21.65541
1800	21.25301	21.29095	21.78782	22.40015	23.53553	25.04844	25.13675
1850	20.82038	20.93358	22.37643	23.43486	25.47328	26.58074	26.97577
1900	20.90793	21.24986	22.41975	23.51298	24.66693	25.53635	27.09429
1950	20.62017	21.23775	23.047	23.80908	25.2649	28.4646	32.27917
2000	22.20515	22.20515	22.20515	22.20515	22.20515	22.20515	22.20515

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
1750	1	21.6554	.	.	.	.
1800	10	22.7088	1.21846	0.38531	21.837	23.580
1850	12	23.7215	1.88847	0.54516	22.522	24.921
1900	25	23.5151	1.59523	0.31905	22.857	24.174
1950	16	24.3036	2.63109	0.65777	22.902	25.706
2000	1	22.2052	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=D, Series=3007
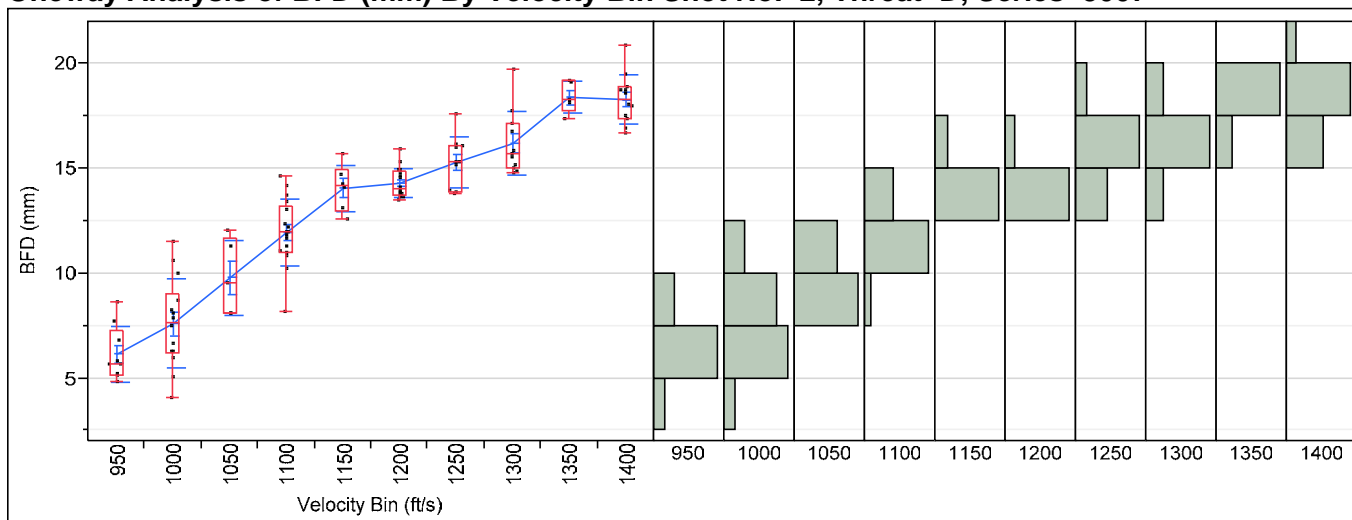
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
950	4.804967	4.804967	5.144563	5.640661	7.249643	8.635651	8.635651
1000	4.017545	4.518529	6.18845	7.660028	9.027788	11.0558	11.49454
1050	8.066677	8.066677	8.08573	9.549438	11.64455	12.04144	12.04144
1100	8.183535	9.798879	10.9958	11.94296	13.21572	14.28124	14.61229
1150	12.56356	12.56356	12.95928	14.17316	14.92377	15.68317	15.68317
1200	13.51278	13.59301	13.7362	14.01839	14.87485	15.49851	15.92144
1250	13.78568	13.7912	13.88707	15.3089	16.06796	17.44911	17.59557
1300	14.78732	14.80741	15.01917	15.70052	17.11513	19.35111	19.74654
1350	17.34315	17.34315	17.72684	18.2558	19.17397	19.20892	19.20892
1400	16.6632	16.72594	17.39523	18.30999	18.85328	20.45058	20.87036

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
950	9	6.1465	1.30000	0.43333	5.147	7.146
1000	14	7.6171	2.12207	0.56715	6.392	8.842
1050	5	9.8020	1.80698	0.80811	7.558	12.046
1100	17	11.9557	1.57467	0.38191	11.146	12.765
1150	6	14.0591	1.11544	0.45538	12.889	15.230
1200	16	14.3127	0.71163	0.17791	13.934	14.692
1250	10	15.3047	1.21979	0.38573	14.432	16.177
1300	11	16.2089	1.52376	0.45943	15.185	17.233
1350	5	18.4115	0.77804	0.34795	17.445	19.378
1400	12	18.3062	1.17482	0.33914	17.560	19.053

## Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=X, Series=3004
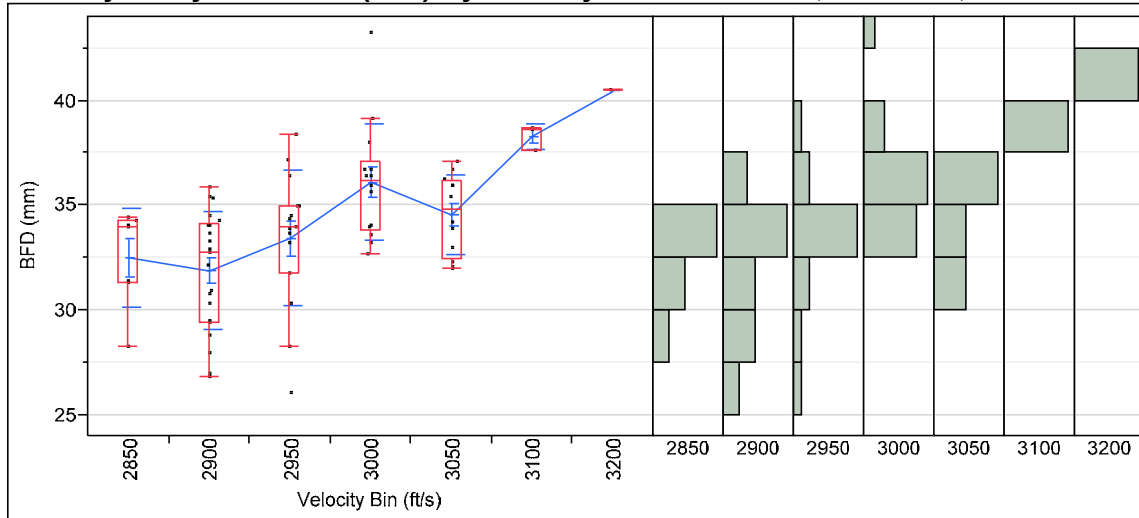
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2850	28.22265	28.22265	31.30235	33.99462	34.24939	34.42493	34.42493
2900	26.84876	27.14632	29.43141	32.74491	34.13404	35.38784	35.89184
2950	26.07582	27.38067	31.7704	33.9457	34.97489	37.62476	38.34015
3000	32.70381	32.9619	33.84275	36.17366	37.04504	41.206	43.254
3050	31.989	32.0097	32.44775	34.81	36.16275	36.9747	37.098
3100	37.63389	37.63389	37.63389	38.62984	38.70084	38.70084	38.70084
3200	40.46579	40.46579	40.46579	40.46579	40.46579	40.46579	40.46579

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2850	7	32.5190	2.32375	0.87830	30.370	34.668
2900	21	31.8841	2.82375	0.61619	30.599	33.169
2950	15	33.4509	3.24603	0.83812	31.653	35.248
3000	14	36.1193	2.78152	0.74339	34.513	37.725
3050	12	34.5583	1.89282	0.54641	33.356	35.761
3100	3	38.3215	0.59657	0.34443	36.840	39.803
3200	1	40.4658	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=X, Series=3005
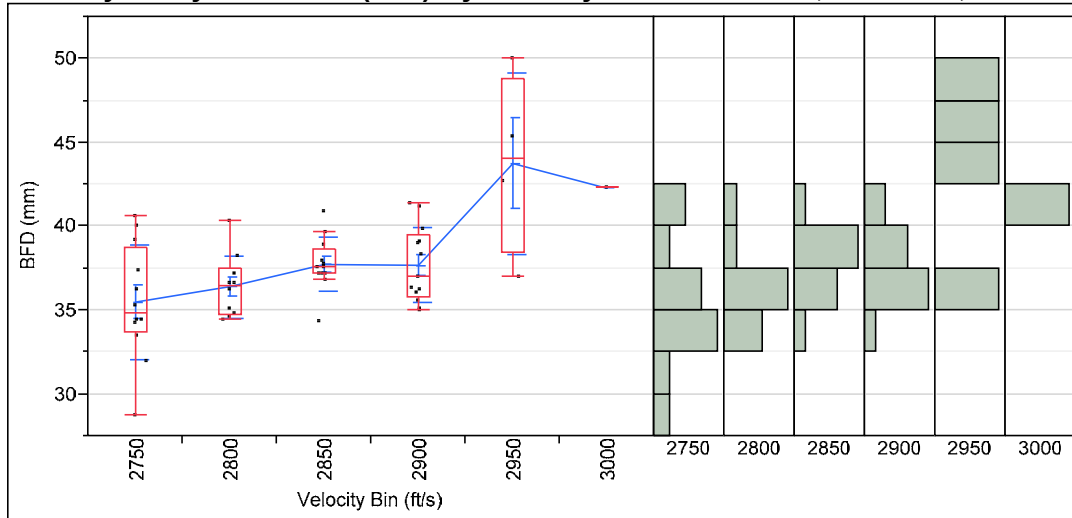
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2750	28.73302	29.71498	33.66164	34.84264	38.73205	40.45436	40.6158
2800	34.47929	34.49013	34.73635	36.4185	37.46155	40.16219	40.37815
2850	34.34454	35.07956	37.1651	37.55791	38.66104	40.54403	40.93434
2900	34.98	35.03458	35.81088	36.98041	39.45367	41.2862	41.333
2950	37.045	37.045	38.45425	44.025	48.8345	49.99	49.99
3000	42.28767	42.28767	42.28767	42.28767	42.28767	42.28767	42.28767

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2750	12	35.4990	3.44856	0.9955	33.308	37.690
2800	10	36.4256	1.86179	0.5887	35.094	37.757
2850	12	37.7468	1.61169	0.4653	36.723	38.771
2900	13	37.6955	2.23282	0.6193	36.346	39.045
2950	4	43.7713	5.40529	2.7026	35.170	52.372
3000	1	42.2877	.	.	.	.

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=X, Series=3006
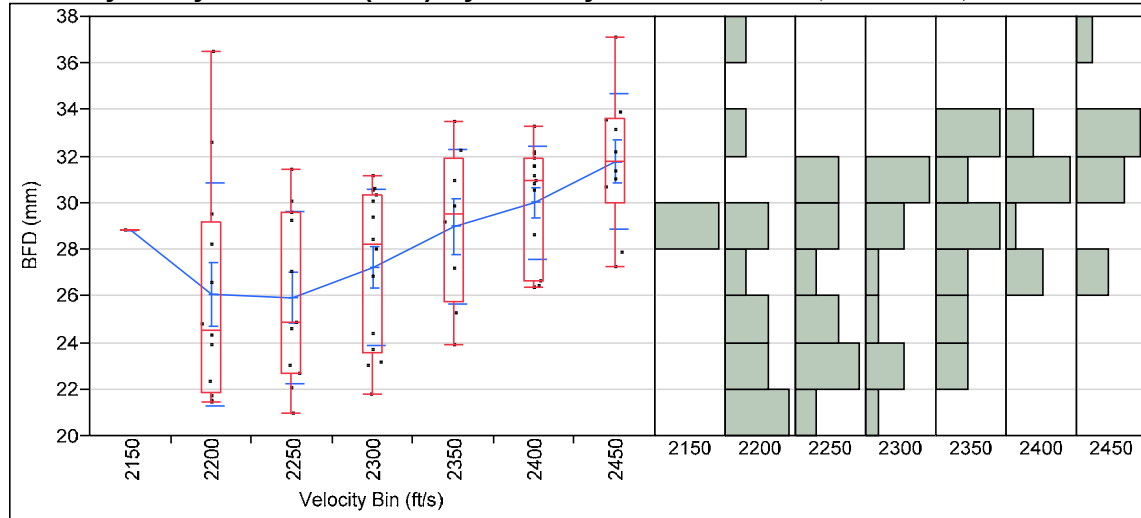
Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
2150	28.84506	28.84506	28.84506	28.84506	28.84506	28.84506	28.84506
2200	21.40376	21.42998	21.83489	24.53471	29.16761	35.324	36.4879
2250	20.93237	21.14998	22.63846	24.87076	29.57426	31.16046	31.43619
2300	21.78874	22.39332	23.58549	28.19586	30.36719	30.91062	31.18252
2350	23.88653	23.88653	25.73497	29.48945	31.92108	33.48581	33.48581
2400	26.38964	26.38964	26.63147	30.984	31.90896	32.61064	33.2692
2450	27.22936	27.29092	29.98438	31.73831	33.64091	36.78478	37.10887

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
2150	1	28.8451	.	.	.	.
2200	12	26.0996	4.79970	1.3856	23.050	29.149
2250	11	25.9384	3.67910	1.1093	23.467	28.410
2300	14	27.2437	3.36141	0.8984	25.303	29.185
2350	8	29.0004	3.35290	1.1854	26.197	31.804
2400	15	30.0348	2.44195	0.6305	28.682	31.387
2450	10	31.7919	2.90770	0.9195	29.712	33.872

Oneway Analysis of BFD (mm) By Velocity Bin Shot No.=2, Threat=X, Series=3007
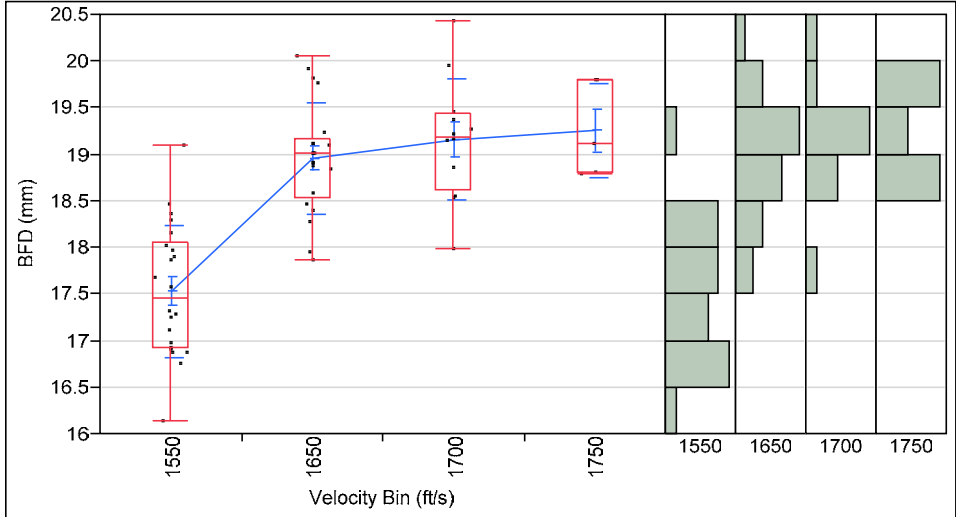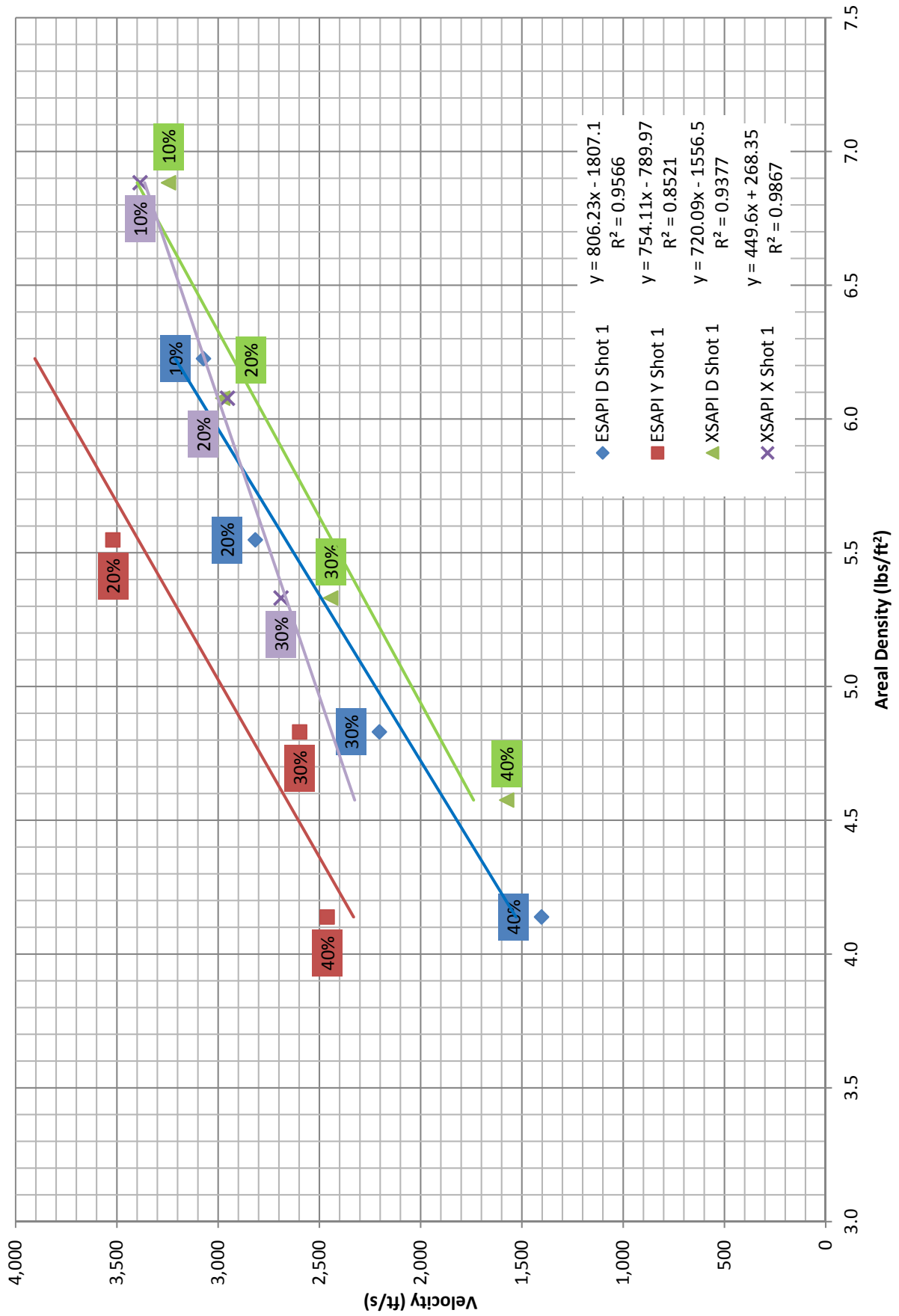

Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1550	16.12846	16.78554	16.9162	17.45026	18.05382	18.43241	19.09859
1650	17.861	18.01689	18.53082	19.00305	19.17295	19.90469	20.04916
1700	17.97933	18.14706	18.62036	19.18859	19.43334	20.29467	20.43815
1750	18.78989	18.78989	18.79966	19.11537	19.80122	19.80226	19.80226

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
1550	22	17.5345	0.709246	0.15121	17.220	17.849
1650	21	18.9623	0.594451	0.12972	18.692	19.233
1700	12	19.1606	0.651877	0.18818	18.746	19.575
1750	5	19.2634	0.507621	0.22702	18.633	19.894

Appendix D. Linear Regressions

Shot 1 CC V50 versus Plate Areal Density

ESAPI D Shot 1 — $y = 806.23x - 1807.1$, $R^2 = 0.9566$

ESAPI Y Shot 1 — $y = 754.11x - 789.97$, $R^2 = 0.8521$

XSAPI D Shot 1 — $y = 720.09x - 1556.5$, $R^2 = 0.9377$

XSAPI X Shot 1 — $y = 449.6x + 268.35$, $R^2 = 0.9867$

Shot 1 CP V50 versus Plate Areal Density

Legend:

- ◆ ESAPI D Shot 1 — $y = 855.48x - 2346.8$, $R^2 = 0.9901$
- ■ ESAPI Y Shot 1 — $y = 643.72x - 541.1$, $R^2 = 0.9755$
- ▲ XSAPI D Shot 1 — $y = 789.31x - 2278.4$, $R^2 = 0.9669$
- ✕ XSAPI X Shot 1 — $y = 641.7x - 1186.1$, $R^2 = 0.9756$

Axis labels: Velocity (ft/s) vs Areal Density (lbs/ft²)
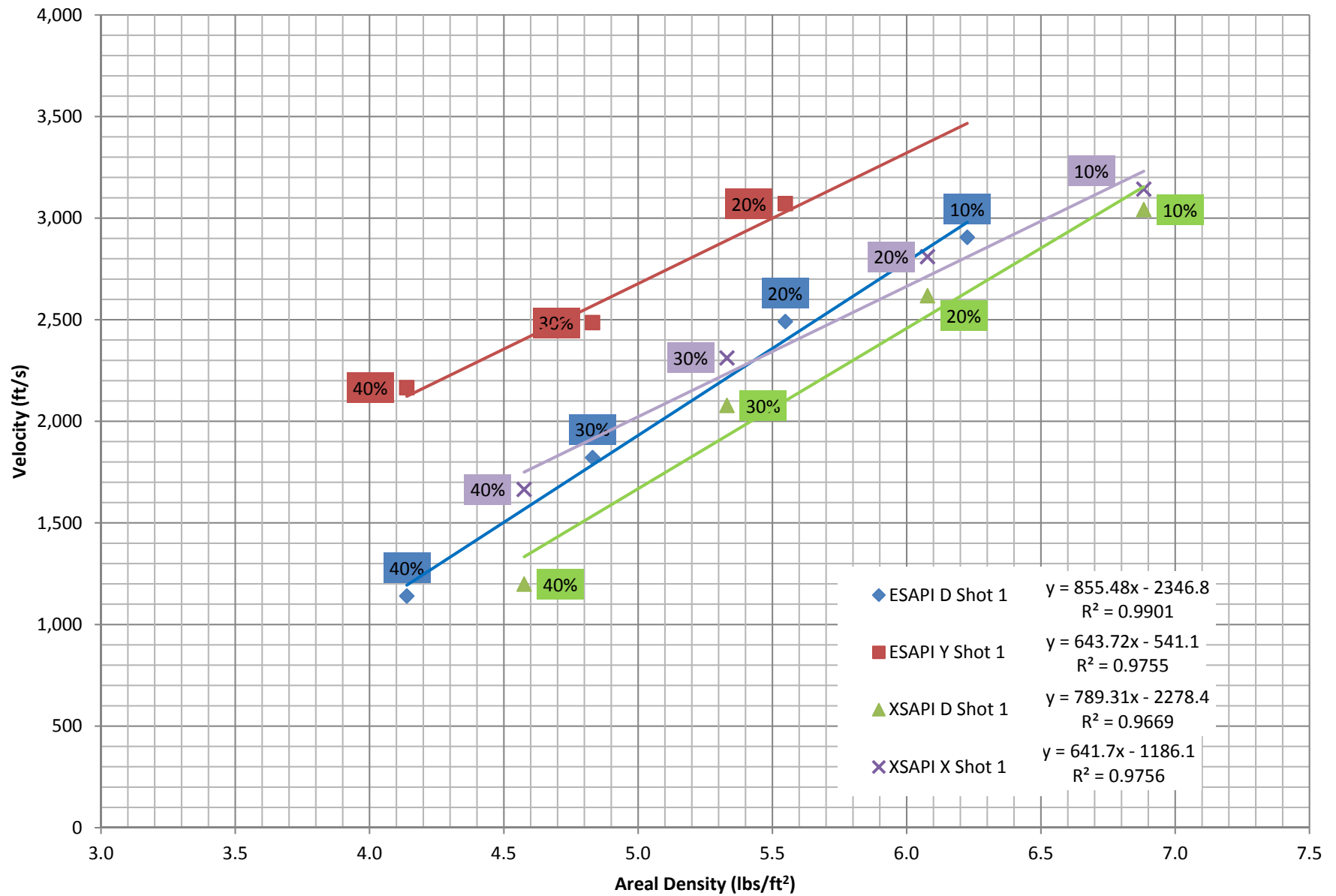
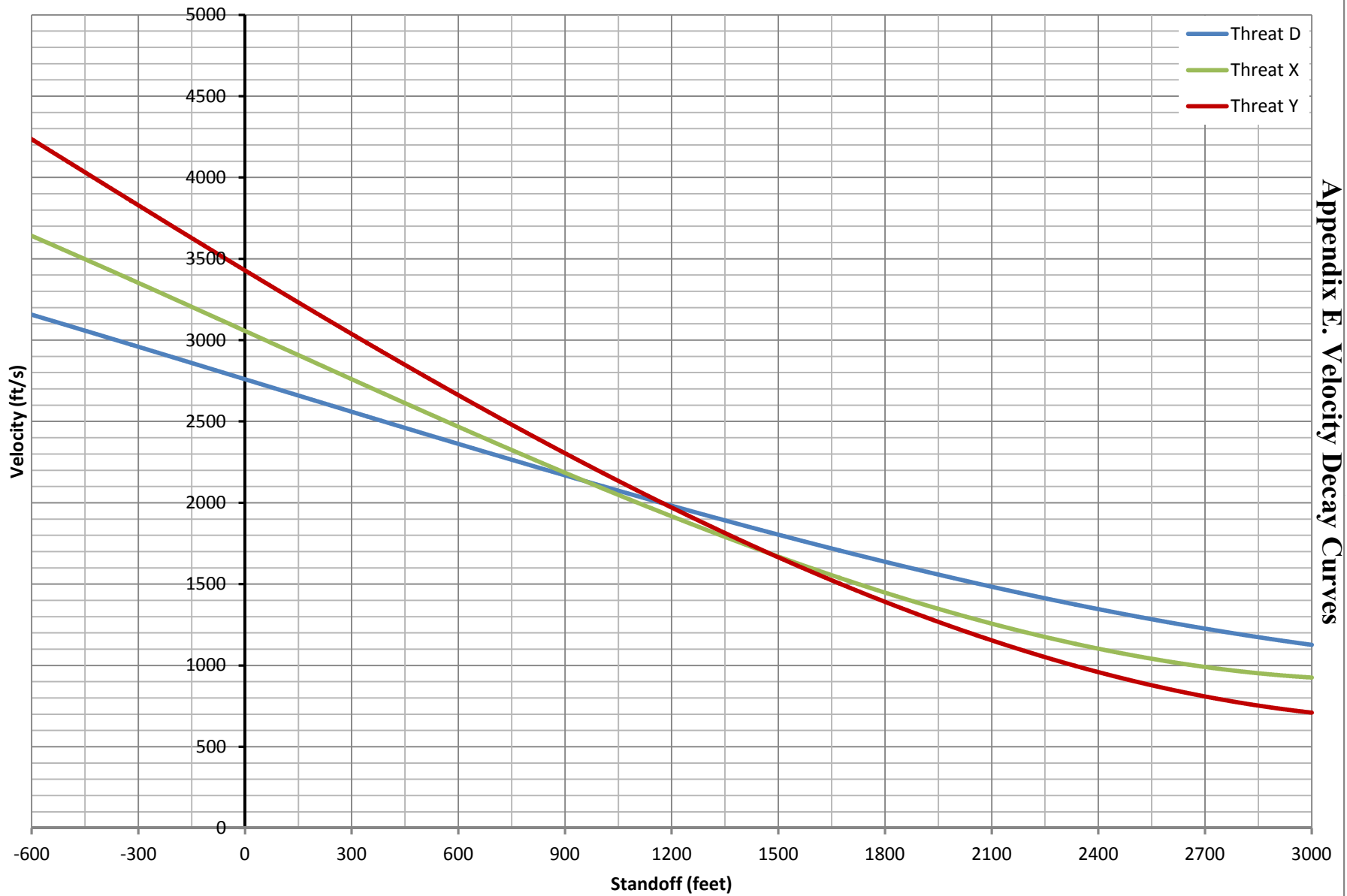**Shot 1 CC V10 versus Plate Areal Density**
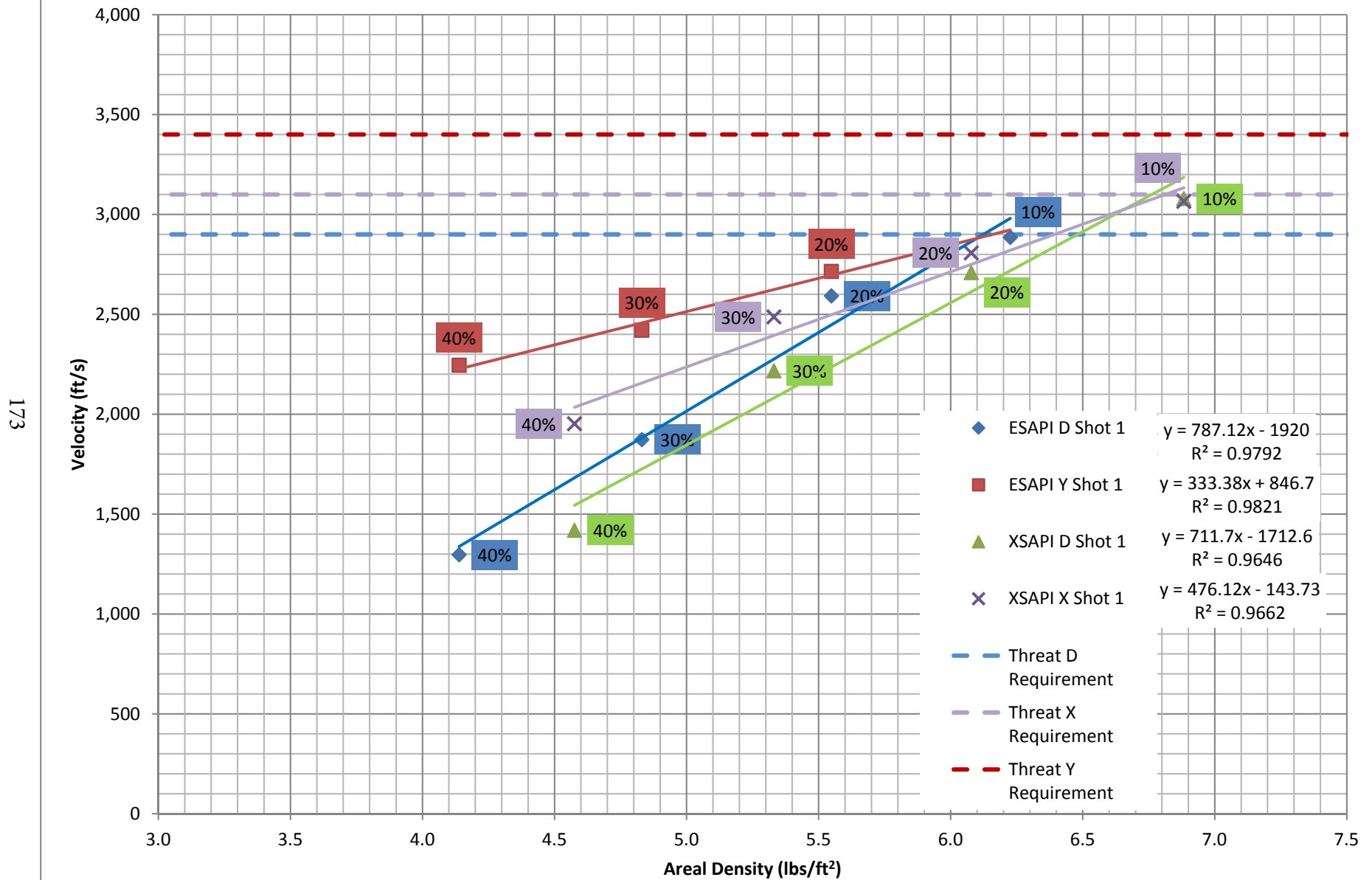
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Threat Velocity Degradation at Range

Appendix E. Velocity Decay Curves

ESAPI Armor Design, Shot 1, V10 Velocity
Overlaid onto Threat Velocity at Range

XSAPI Armor Design, Shot 1, V10 Velocity
Overlaid onto Threat Velocity at Range